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THE HOME STUDY OF CORAL REEFS*

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In the statement at the beginning of the second paragraph above, the phrase, "previously eroded valleys," occurs. This should be emphasized, for it is evident that embayments of another kind, namely, those formed by the irregular growth or by the partial engulfment of a volcanic island, do not indicate subsidence. Hence it is important that valleys of erosion, such as are normally excavated by consequent streams on the slopes of an extinct volcano, should be distinguished from the depressions between lava-flow promontories, and from the graben-like depressions or engulfments by which the slopes of volcanic cones are sometimes breached. A characteristic feature of valleys of erosion, and one in which they differ from engulfed graben, is their somewhat symmetrical repetition all around a volcanic cone,—unless one side be much drier than the other; another characteristic feature is the outcrop of eroded lava beds on the valley sides, and in this way valleys of erosion differ from unfilled depressions between two non-eroded flows. Depressions of uncertain origin may of course occur in the flanks of one volcano or another, but, as a general rule, valleys of erosion can be recognized; and it may be fairly believed that the depressions occupied by bays in the central islands of so many barrier reefs are true valleys of erosion, simply on the evidence of their form and their radial arrangement as represented on large-scale charts.

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* Concluded from pp. 561-577 and 641-654.

The logical value of this consequence in giving support to the theory of subsidence is very great, inasmuch as the facts, for which it provides the mental counterparts, were entirely unknown when the theory was invented; inasmuch as they are not accounted for by any other theory, with the possible exception of the eighth in the present list; and inasmuch as they are easily recognizable and indisputable—much more so indeed than the evidence supplied by biotic relations.

A corollary of the formation of embayments by the subsidence of a dissected island is that the growth of deltas will be prevented, or at least retarded; for a short stream draining a small valley may not be able to build up a delta fast enough to keep the sinking delta surface above sea level; but, on the other hand, a larger river draining an extensive catchment area may bring down so much sediment as to fill an embayment and build forward its delta as a salient, even if the delta growth is reduced by subsidence to a less rapid rate than it would have on a still-standing island. Hence the deltas formed by certain rivers on the larger islands of the Fiji group do not of themselves necessarily testify to a still-stand, much less to an elevation of those islands.

A second corollary is that the lagoon deposits, consisting chiefly of horizontally bedded limestones with interbedded gravels, sands and muds along their inner margin, must unconformably overlie a more or less eroded and dissected land surface; thus, in their relation to the volcanic rocks that they cover, as well as in their own structure, they are significantly different from the reef-mass formed by outgrowth from a still-standing island; and in uplifted reefs these differences ought to be discovered by critical search.

A third consequence of the present theory is that, like elevation, subsidence may be unequal in the neighboring islands of the same group; for there is no reason to suppose that the deformation of the ocean bed is perfectly uniform. This consequence is of peculiar interest, because it is unlike the uniform rising of the sea in all parts of the ocean, by which, according to the last theories here to be discussed, the effects ordinarily ascribed to subsidence are accounted for. Unequal subsidence may, however, be difficult to recognize in nature. A test case may perhaps be imagined:—let a newly uplifted, elongated island suffer partial dissection while a fringing reef is formed around its shore line; let it then be elevated some 500 feet, and let mature valleys be eroded down to the new sea level, while a new fringing reef is formed around the new shore line; finally, let unequal subsidence take place, whereby the

island is depressed only fifty feet at one end and 500 at the other, and, during this subsidence, let the second fringing reef be transformed into a barrier reef. As a result of all these changes, the island will have a slightly embayed shore line at one end where the remnants of the first formed fringing reef stand 450 above sea level, and a deeply embayed shore line at the other end, where the first reef remnants will be at sea level; and the new barrier reef will stand near the slightly embayed end of the island but farther out from the other end. Indeed, even without the remnants of the elevated fringing reef, the systematic relation of increasing length of the drowned-valley embayments and the increasing width of the barrier-reef lagoon, from one end of the island to the other, would go far toward demonstrating unequal subsidence. If a long island were depressed at one end and elevated at the other, the increasing effects of these opposite movements on either side of the medial fulcrum might be recognized. There have been abundant speculations of a general nature regarding unequal subsidence of large oceanic areas, but few if any detailed studies of unequal subsidence in single groups of islands; yet it would seem that, in the many island groups of the Pacific, the peculiar consequences of unequal subsidence here pointed out might be found. They should certainly be looked for.

A fourth consequence must not be overlooked. If subsidence has taken place in the Pacific Ocean over a large area and to a great amount in modern geological time, as Darwin inferred from the features of coral reefs, and as some zoologists are prepared to demonstrate on the evidence of related faunæ of many islands, a large volume of water must have been supplied from elsewhere to cover the subsided area. It is sometimes assumed that the needed water volume was drawn from all parts of the ocean, and that as a result the sea level would be everywhere depressed and many shallow sea bottoms would be laid bare as lowlands on continental borders. When it is found that lowlands of geologically modern emergence do not appear to be so extensive as this argument demands, wide-spread modern subsidence in the Pacific is held to be disproved.

But the assumption that the needed water volume is drawn from all parts of the ocean is unnecessary and improbable; for it is based on the associated assumption that the only sea-bottom change is in the region of subsidence, and this is unreasonable. It should not be supposed that the subsidence of a large area in the Pacific means that the earth-radii beneath it have been simply shortened,

as if that part of the earth's inner substance had contracted. It is vastly more reasonable to suppose that, if a certain Pacific area subsided, adjoining areas were at the same time upheaved by a lateral transfer of sub-crustal material from beneath the subsiding area; furthermore it is not unreasonable to suppose that the volume of crustal upheaval is about the same as the volume of crustal subsidence; and in such case no great amount of water would be withdrawn from other parts of the ocean, and few continental lowlands would emerge; indeed if part of the subsiding area had been previously above sea-level, as in a mid-Pacific continent, while none of the upheaved areas rose above sea-level, then on the assumption of equal crustal volumes being depressed and upheaved, the effect of the double change would be, not to lower, but to *raise* the general surface of the ocean, and thus to submerge continental lowlands and to produce innumerable rias by drowning valleys. The upshot of all this is that, as the conditions of compensation for subsiding areas are unknown, this consequence of the theory of subsidence need not be pursued further.

When Darwin's evidence is supplemented by the evidence of shoreline embayments and by that of related plants and animals, the theory of subsidence appears successful in explaining a great number of barrier reefs, and it thus becomes probably successful in explaining atolls also. It has an admirably ingenious simplicity. Its main postulate is reasonable, particularly in the revised form of prevailing and predominating subsidence, not infrequently interrupted by pauses and occasionally alternating with small uplifts. The theory of subsidence therefore appears to be well supported by the review here made. It is gratifying to see that it is supported also by the recent observational studies on Pacific reefs made by Hedley, Taylor, Marshall and other Australasian investigators. Judgment as to its verity must, however, be suspended until certain other theories have been considered.

Uplifted Reefs, worn down.[18] Certain fringing and barrier reefs and atolls are surmounted by more or less disconnected masses of calcareous rock, up to a hundred feet or more above sea-level. It is believed that such masses are remnants of formerly larger sea-level reefs or deep-sea limestones, which have uplifted and more or less completely worn away; the present sea-level reef being established on the denuded outer margin of the older mass; hence, in this connection, the general study of uplifted reefs may be in-

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[18] A. Agassiz: The Islands and Coral Reefs of Fiji, *Bull. Mus. Comp. Zool., Harv. Coll.*, Vol. 33, 1899. See p. 43.

troduced. If the present sea-level reef be a barrier or an atoll, the floor of the enclosed lagoon would, according to this theory, have to be reduced below sea-level by the action of solution or other destructive process on the uplifted limestones. It may be noted that the destruction of the uplifted reef must usually be ascribed to non-marine erosion, because the growth of reef-building corals along the new shore line will ordinarily defend it from the attack of the sea.

The structure, and hence the condition of formation of an uplifted limestone is seldom specified. If it be a deep-sea limestone, its even bedding and its fossils should reveal its origin; and in this case the relation of the limestone to its foundation would be of particular interest, for if the contact of the two be unconformable, a great subsidence previous to the deposition of the deep-sea limestone would be indicated. If the elevated limestone were formed as a reef around or upon a volcanic island without accompanying subsidence, the structure of the reef should, as noted under the second and third theories here discussed, give indication of such an origin, provided that the reef is not too much worn away; in this case the foundation, where covered by so much of the uplifted reef as still remains, should not be an eroded surface, for that would indicate that the foundation was a subsided instead of a still-standing island. Furthermore, some signs of erosion of the central island, if one be present, and of deposition of its detritus in deltas with respect to the former base level should be found at a height at least as great as that of the highest visible parts of the uplifted reef now remaining. Again, a deeper erosion of the central island and of its earlier deltas should have taken place with respect to the present base level since uplift, and to an amount appropriate to the dissection and denudation of the uplifted reef; if the uplifted reef be seen only in small remnants, the deeper erosion may now be so far advanced as to have destroyed all traces of the earlier erosion. Deltas deposited since uplift should form conspicuous salients if the central island be large and if the uplifted reef be nearly consumed; but the delta heads should not fill former embayments, because the shore line of a volcanic island, when uplifted for the first time, has no such forms. Finally, neighboring islands should not exhibit biotic relations, indicative of evolution from common and somewhat remote ancestors, for such kinds of their plants and animals as are not capable of transporting themselves, and as are not subject to accidental transportation.

It is, on the other hand, conceivable that the uplifted limestones

may represent a reef formed during a former period of subsidence. This would seem to be eminently possible in the case of uplifted limestones that surmount, by a moderate altitude, the reefs of atolls, the mass of which rises in flat-topped cones from a considerable depth and in such a form as could hardly be imitated by the uplift of blocks of wide-spread, deep-sea strata; especially if these atolls are associated in such a way with neighboring barrier reefs possessing embayed, central islands as to make it probable that subsidence has had a dominant share in the formation of both. In the case of an uplifted barrier reef, formed during subsidence and still well preserved, the reef structure, the lagoon limestones, the former shore line features of the central island, and the unconformable relation of the reef mass to the foundation that it buries, should all correspond to the conditions outlined under Darwin's theory: in the uplifted reefs of Cuba, an eroded foundation surface and an unconformable contact is implied by Crosby's statement,[19] that the reefs rest on "ancient and non-calcareous mountains," and by Hill's structural cross sections[20]: this demonstrates subsidence before or during the deposition of the reefs. Furthermore, the present shoreline of the central island might, in case uplift occurred long ago, exhibit resurrected or re-excavated valleys, bordered with terracing remnants of their former deposits, and floored with new, low-level flood plains, sloping gently to the sea, and fronted with salient deltas; but there should be no unfilled embayments. In the case of uplifted and greatly denuded barrier reefs, on or around which a new barrier reef has been formed, it would of course be difficult to apply the structural tests regarding the origin of the earlier reef. In barrier reefs as well as in atolls which bear remnants of denuded uplifted reefs, if the lagoon is as much as twenty fathoms in depth, it could be best accounted for, as Darwin noted, by slight subsidence after greater uplift and extensive denudation.

Special attention should be called to the unlike features presented between recently uplifted reefs that had been previously formed by outgrowth around a still-standing central island, and recently uplifted reefs that had been previously formed by upgrowth around a subsiding central island. Reefs of the first kind should contour around the former shore line, but without entering any valleys that may have been eroded with respect to the then

[19] W. O. Crosby: On the Elevated Reefs of Cuba, *Proc. Bost. Soc. Nat. Hist.*, Vol. 22, 1882, pp. 124–130. See p. 125.

[20] R. T. Hill: Cuba, *Natl. Geogr. Mag.*, Vol. 9, 1898, pp. 193–242. See p. 201.

sea-level; its thickness, as revealed by borings, should be fairly uniform at a given distance from the former shore line, and should increase with much regularity seaward. Reefs of the second kind, or their lagoon limestones, should enter every valley, so as to extend inside of a line connecting the outermost outcrops of volcanic rocks in the spur ends at the former shore line; the thickness of the reef deposits should increase opposite each valley, and decrease opposite each spur. Silence of observers regarding these strongly contrasted features, as well as regarding reef structure, makes it impossible at present to decide as to the origin of uplifted reefs; for, as far as I have read, few of the facts corresponding to these special consequences have been looked for, probably because the consequences have not been consciously deduced by the observer who had the chance of looking. Lister has described the uplifted reefs of the Tonga Islands,[21] but does not specify their structure. Andrews has studied a number of uplifted reefs in the Fiji group[22] and shows that some of them, at least, are largely composed of horizontally bedded, non-coralline limestones; this would seem to suggest upward rather than outward growth: whether these reefs lie on eroded or non-eroded foundations is not clearly brought forth. Even if looked for, some of the facts may be hard to find; but it would seem that the relation of an uplifted barrier reef to the valleys in the dissected volcanic mountain that it surrounds ought to be easily discovered. In the absence of special records, judgment should be suspended for the present.

The limestones of some of the uplifted and denuded masses, which surmount modern reefs, are said to be of Tertiary age; but the evidence on which this date is ascribed to them is not published in full. In any case the date of the limestones—so long as they are geologically modern—is not so significant in its bearings on the origin of coral reefs as has been intimated, inasmuch as any good theory of reef formation should apply in one geological period as well as in another. Should the uplifted limestone masses be shown to be largely of coral reef and lagoon origin, and of such structure as indicates subsidence during their formation, a very simple and reasonable addition to Darwin's main theory, which he himself recognized (Coral Reefs, p. 140), would suffice to account for them; and the theory would thereby be recommended as providing the counterparts of a somewhat remote as well as of a geologically

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[21] On the Geology of the Tonga Islands, *Quart. Journ. Geol. Soc.*, Vol. 47, 1891, pp. 590-617.

[22] Notes on the Limestones and General Geology of the Fiji Islands, *Bull. Mus. Comp. Zool., Harv. Coll.*, Vol. 38, 1900.

recent past. Should the limestone masses bear indication of formation as outgrowing reefs on still-standing islands, or of deposition on a deep-sea bottom, other theories than Darwin's would be thereby supported.

It has been suggested that the theory of uplifted and worn-down reefs might find a wide application in explaining many reefs and atolls, in which practically all the uplifted mass has been worn away; but to suppose "that the uplifted parts [of existing atolls] have been worn down by the surf, and thus have escaped observation, is overruled by the very considerable depth of the lagoons of all the larger atolls," as Darwin noted years ago (Coral Reefs, p. 146); and to suppose that existing barrier reefs have been similarly uplifted and worn down is negatived for many cases by the drowned valleys of the central islands, as Dana might have pointed out. It may be added that a barrier reef could not be formed in this way around an island on which elevated reefs still exist as fairly continuous terraces, for that would be blowing hot for the worn-away uplifted reef and cold for the still-preserved uplifted reef, in the same theoretical breath; and yet barrier reefs around islands that bear uplifted reefs are not unknown.

8. *Coral Reefs and the Glacial Period.*[23] An exceptionally ingenious theory for the explanation of coral reefs remains to be considered. In essence, it postulates still-standing banks or islands, on or around which reefs of various dimensions had been formed by upward and outward growth in preglacial time; then, on the advent of the glacial period, sea-water is withdrawn to supply glaciers and ice sheets on the continents and the sea-level is lowered 200 feet or more, and at the same time the corals on most of the reefs are killed. Thereupon the sea waves attack the undefended slopes of the reefs and cut them down to a smooth platform a little below the sea-level of that time; afterwards, with the re-establishment of a milder climate, coral larvæ, floating from reefs that have not been killed, re-establish themselves on the outer border of the platform, and, with the melting of the continental glaciers and the rise of sea-level, the new reef grows upward and encloses a lagoon, of which the depth and the smooth floor are thought to be better accounted for in this way than in any other. Islands like the Maldives are regarded as truncated reefs, incompletely built up to present sea-level.

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[23] A. Penck: Morphologie der Erdoberfläche, Stuttgart, 1894, Vol. 2, p. 660.
R. A. Daly: Pleistocene Glaciation and the Coral Reef Problem, *Amer. Journ. Sci.*, Vol. 30, 1910, pp. 297-308.

A still-standing bank or island is here, as in other theories, improbable. The withdrawal of sea-water to form continental glaciers and the lowering of the sea-level during the glacial period is not to be doubted: it must have taken place repeatedly, for whether ice-free interglacial epochs occurred on the continents or not, great advances and retreats of the continental ice-sheets certainly took place; as the successive advances were of different measures, the successive lowerings of the sea-level must also have been of different measures; the several periods of greatest lowering must have been relatively short. The maximum number of feet by which the sea-level was lowered may have been less than the amount above quoted, because the depression of certain glaciated lands, like Labrador and Scandinavia, while ice sheets lay on them, was presumably compensated by an uplift of the neighboring sea floor, and that would have tended to raise the sea-level. Whether the reduction of the ocean temperature was sufficient to kill the corals on most of the reefs or not is truly a difficult matter to determine; but if it be for the moment assumed that the corals of most reefs were killed, a number of peculiar consequences, not announced in the original statement of the theory, remain to be deduced.

Plants and animals on neighboring islands would not show relationships indicative of slow change from common ancestors, unless the depth of water separating their islands was less than the lowering of sea-level during the glacial period; and the evolutionary changes from common ancestral forms would not be greater than could have taken place in Pleistocene time.

Barrier reefs and atolls on which the corals were not killed would have been defended from wave attack, for the corals would have migrated down the outer slope of the reef as the sea was lowered. The reefs thus defended should include all those which are surmounted by elevated limestone masses, such as were considered under the preceding theory, on their outer margin overlooking a submarine slope into deep water: for had the reefs not been defended, all such elevated masses, well exposed to undermining by sea attack, would have been cut away by the waves while the sea stood at its lower level. It is significant that several examples of such surmounting limestones occur in the Fiji Islands and many more in the Paumotus, as described by Agassiz: he instances some small islands on the rim of an atoll (Ngele Levu) in the northeast part of the Fiji group, which "consist entirely of coral rock elevated to a height of over sixty feet on the larger

island,'' and with deep water up to the shore line on the north side.[24] Some of the uplifted limestones observed in the Paumotus are described as ''Tertiary''; if their more definite date were late Pliocene or early Pleistocene, that would prevent their interpretation as having been formed and uplifted in postglacial time. Hence the corals on these reefs and in many other reefs farther west were presumably not killed during the glacial period, and this element of the present theory would therefore seem to have less wide-spread application than has been urged. The lagoons of these reefs are not exceptionally shallow; and yet according to the present theory they should be so; and furthermore, when uplifted ''Tertiary'' limestone occurs on a barrier reef, thus testifying to the persistence of the reef during the glacial period, deltas should extend forward into the lagoon from each valley of the central island—in so far as the preglacial lagoon floor and the deltas were not cut down by stream channels, or worn by solution into irregular honeycombed forms, while the sea was lowered. So far as the structure of the reef is determined by boring or otherwise, it should exhibit the outward-dipping strata characteristic of reefs formed on still-standing islands, and it should have a minimum of horizontal lagoon strata. The breadth of the reefs should be proportionate to the length of preglacial time during which the reef had been growing outward, and hence to the dissection of the central island also. The central islands, which could have had no drowned valley embayments in preglacial time, because no subsidence had then taken place, should now have drowned valleys only of such length and breadth as could have been eroded in the floors of the preglacial valleys while the sea was lowered; this point is considered in more detail below.

All oceanic islands of preglacial date, outside of the coral and the glacial seas, should have a sea-cut platform of breadth proportionate to the duration of maximum glaciation, and now submerged in some 200 feet of water; cliffs, more or less completely submerged, should rise from the inner border of the platform, and drowned valleys should extend inland. All continental coasts should have similar features, except in so far as they were covered by ice, or in so far as the continents themselves suffered changes of level by which the development of these features was modified or prevented.

Atolls on which the corals were killed could hardly have been

[24] A. Agassiz: The Islands and Coral Reefs of the Fiji Group, *Amer. Journ. Sci.*, Vol. 5, 1898, pp. 113-123. See p. 116.

truncated to a uniform depth unless they were comparatively small, for the level truncation of a large atoll demands a long stand of the sea at its lowest level during a single glacial epoch, and the return of the sea to the same lowest level in successive glacial epochs; and these are unreasonable postulates. The complete truncation of an atoll to one level could have been accomplished only during the maximum phase of the glacial epoch which abstracted the most water from the sea, and a single maximum phase could have hardly held its value long enough for the level truncation of a large atoll. During the rise of the sea, when abrasion was most effective, the waves would have cut a slanting platform in so much of the atoll as was not already worn away; hence the level surface of truncation, which is regarded as a characteristic result of this theory, seems of improbable realization in large atolls; and some other cause should be found for the smooth lagoon floor of large atolls such as seem to be thus truncated. Very large atolls, on which the corals were killed, might not have been completely truncated, and hence should to-day possess a mesa-like shoal or island in the center of their lagoon; and very broad barrier reefs, not protected by living corals during the lower stand of the sea, might still retain a bench-like part of their preglacial surface, more or less completely delta-covered, around the base of the central island; the bench might be trenched if crossed by streams, and the trenches would now be occupied by bays; outside of the bench, an abraded platform, cut to a lower level, would be submerged and enclosed as a lagoon by a new reef. But the great barrier reef—nearly an atoll—of Hogoleu, or Truk, in the Caroline Islands, thirty miles in diameter, shows no residual bench although its lagoon is from twenty to thirty fathoms in depth.[25]

The form of the valleys eroded in the central island of a barrier reef during the lower stand of the sea and now drowned, demands special consideration in relation to the features produced by marine abrasion. The most significant element of such valleys to-day is not their depth, for that may have been diminished by an unknown measure of deposition, but their breadth in relation to that of the preglacial valleys beneath which they were deepened; for their breadth would be little changed by the waves of the quiet lagoon waters and this change could be recognized and allowed for. Let it be remembered that the preglacial valleys extended to the island border, for no embayments could have existed then; hence the

[25] A. Agassiz: The Coral Reefs of the Tropical Pacific, *Mem. Mus. Comp. Zool., Harv. Coll.*, Vol. 28, 1903, p. 354.

whole length and width of the present embayments must result from the drowning of the deep-cut valleys of the glacial period.

In case the preglacial valleys were narrow, because the islands in which they were eroded had been formed shortly before the date of the glacial period, the deepening of the valleys during glacial times might so completely undercut the walls of the previously eroded valleys that the latter could not be recognized to-day. But if the island were ancient enough to have suffered mature erosion in preglacial time, the incision of deeper valleys during the glacial period might not undercut the higher slopes of the enclosing ridges and spurs; and thus two-cycle valley forms might be produced. Two cases may be here distinguished; namely those of small and of great abrasion, as a result of short-lived and long-lasting abrasion during a lower stand of sea-level.

Short-lived abrasion would, as above noted, leave unconsumed benches in large atolls and in wide barrier reefs; but it might almost completely truncate a small atoll, or almost completely remove a narrow barrier reef; its complete success in such removal would be prevented by the resistance of the volcanic rocks as soon as a contraposed[26] shoreline was developed. Corresponding stream erosion on the central island would produce only narrow gorges; and these when drowned would give rise to narrow bays enclosed by steep walls rising to an "edge" or shoulder, where they undercut the gentler slopes of the preglacial valley sides. The "edge" must be carefully distinguished from a structural bench formed by the outcrop of a single lava bed: a true "edge" should be relatively indifferent to structure; it should begin close to sea-level at the outer rim of the island, for, as above remarked, the preglacial valleys must have mouthed at the outer rim, and, gradually rising, it should extend a good distance inland.

Long-lasting abrasion would completely truncate all but the largest atolls, and completely remove all but the largest barrier reefs. A central island that was surrounded by a narrow barrier reef in preglacial time, would in this case lose all of its reef, and would have a platform abraded in the volcanic rocks all around its border, so that the mountain spurs would all be cut off in cliffs; at the same time the streams would erode open valleys; and these, when drowned by the rising sea, would form open bays, the sides

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26 The term, contraposed, has been lately suggested by Clapp (*Mem. 13, Dept. of Mines, Geol. Survey Branch*, Ottawa, 1913) to designate a shoreline on resistant rocks that have been laid bare by the removal of the weaker deposits that once lay in front of them. Many examples of locally contraposed shorelines are found along the New England coast, where the abrasion of drift has laid rock ledges bare. Contraposed shorelines thus correspond to superposed rivers.

of which would be but moderately precipitous up to a rounded "edge" or shoulder, above which the preglacial spur slopes were not encroached upon by the new valley. The lagoon waters would rest against the spur-end cliffs, from which the talus might not yet rise from the drowned cliff base to sea-level. In case it be supposed that the total period of lower sea-level was long enough for the mature widening of the deepened valleys, so that all traces of preglacial forms were undercut and destroyed, then the spur-end cliffs should be cut so far back as to become conspicuous features.

It is not possible to say definitely at present whether actual forms, fully corresponding to either of these groups of deduced forms, occur or not; but it may be suggested that if the forms of either group were of general occurrence, their details would probably have been noted. As far as large-scale charts suffice to show the facts, the embayments that prevail in the central islands of barrier reefs are wide rather than narrow, yet the spurs are not shown to be cut off in cliffs; their ends usually taper down and disappear gradually beneath the lagoon waters. The excellent model of Bolabola, a typical barrier reef island in the Society group, made from personal observation by G. C. Curtis for the Museum of Comparative Zoology at Harvard University, gives no indication of two-cycle valleys or of cliffed spur-ends.

It is, however, possible that the cliffs of the Marquesas Islands, situated where the cold waters of the Humboldt Current have just become warm enough for coral growth, but where coral reefs are to-day scanty or wanting, may be explained by an early extinction of corals at the beginning of the glacial period, by the abrasion of the reefs and energetic cliff-cutting during the lower stand of the sea, and by the failure of corals to re-establish themselves on the cliffed shore line in postglacial time. On the other hand, no case of the opposite kind, namely, a broad reef with a very shallow lagoon or no lagoon, in the warmest part of the Pacific, as an example of a reef on which the corals were not killed, and which was therefore not truncated during the lower stand of the sea, has been safely identified; and this is the more adverse to the present theory, when it is recollected that the corals of the Paumotu atolls, south of the Marquesas, appear to have survived the refrigeration of the glacial period, as above stated; and hence that they and many other reefs of the warmer ocean, farther westward, ought, according to this theory, to have very shallow lagoons or no lagoons, instead of lagoons of ordinary depth, such as they actually possess.

Inasmuch as some lowering of sea-level during the glacial period is not to be doubted, although the amount of lowering is uncertain, and inasmuch as one or the other group of consequences of such lowering, as deduced in the preceding paragraphs, ought to be repeatedly and consistently found in actual coral reef islands, we seem to be left in a quandary when, on recourse to the facts as far as they are now known, it appears that neither group of deduced consequences is verified. A partial escape from the quandary may be found by rejecting the postulate that the corals of most reefs were killed by the colder ocean waters of the glacial period—it being remembered that good warrant for such rejection is given by the occurrence of uplifted limestones in the Paumotus and other island groups; for then the reefs would have been protected from abrasion and the ends of the spurs would not be cliffed: but signs of two-cycle valleys ought in this case to be found on some islands.

Another escape from the quandary is found by rejecting the postulate of still-standing islands, and by combining the essential elements of the theory here under discussion with the second earlier theory—Darwin's theory of subsidence—whereby the consequences of a lowered sea-level would, in nearly all islands, be lost by submergence, unless exceptional instances of pauses in subsidence allowed the effects of lowered and raised sea-level to stand forth alone, just as a pause in subsidence has allowed the growth of deltas around Tahiti. If the two theories were thus combined, the present theory would, geologically considered, take rank as a subordinate complication of Darwin's theory, like brief still-stands or temporary uplifts; but it would be of little import geographically, because its consequences would be so generally invisible.

Review of the Preceding Discussion. One result of the preceding discussion is, to the present writer, more surprising than any other; namely, the relative indifference shown by many investigators of the coral reef problem, to the deduction of unexpected consequences from the theories that they announce, and, as a corollary of this, the incomplete confrontation of deduced consequences with appropriate facts as a means of testing the value of the theory from which the consequences are deduced. It would therefore seem that some other method of investigation than the one set forth in the introductory pages of this essay must have been satisfactory to these investigators, but what this other method may be does not clearly appear.

Surely all investigators must recognize that observation alone

will not suffice to discover the origin of coral reefs, and that recourse must therefore be had to speculating on past possibilities, to imagining unseen processes, to inventing hypothetical explanations, in the hope of thus coming upon the mental counterparts of past verities in the formation of coral reefs. Indeed, the very fact that different investigators have announced different views should make it clear that appeal must be made to some decisive method of testing the different views or hypotheses or schemes that have been suggested; and as far as I have been able to penetrate the matter, there is no other way than the one above indicated:—the careful deduction of all possible consequences from each invented theory, the fair-minded confrontation of the several sets of consequences with the appropriate facts, and the impartial judgment as to the success of the confrontation. It has been in accordance with this plan that a careful search has been made, as above set forth, for all the consequences of every theory of coral reef, with the result, as already stated, of more or less definitely excluding certain theories, and of more or less definitely establishing certain others. Yet, evidently enough, a much less elaborate method of investigation has been sufficient to convince many observers of the correctness of their inferences, which, as here analyzed, seem unsatisfactory.

But it is not only exploring investigators of coral reefs who have been satisfied to accept theoretical explanations on what are here regarded as insufficient grounds. Various home students of this problem have also been willing to accept or to reject one explanation or another for similarly insufficient reasons. Thus after the theory of outgrowing reefs on still-standing islands had been announced, various writers gave up the previously accepted theory of upgrowing reefs on subsiding islands without asking for any test—such as drowned valley embayments or peculiar biotic relations—by which a discriminating choice might be made between the two theories. Again, on the discovery of a new cause of change in the relative attitude of land and sea, such as is provided by the withdrawal of ocean water to form the continental ice sheets of the glacial period and the return of the water on the melting of the ice sheets, this new cause was, by some, taken as substitute for the previously suggested cause of change of level as provided by subsidence of the ocean bed, yet again without the presentation of decisive tests that should exclude the earlier and confirm the later suggestion, and without asking whether a combination of both causes acting together would not provide a better explanation of the total phenomena than could be secured through either cause

acting alone. It is therefore quite as much on account of diversity in method of discussion as on account of difference of emphasis placed on divers facts, that the coral reef problem has been differently solved by different students.

Another result of the preceding discussion is also significant; namely, that the conscious and critical examination of the various theories of coral reefs can lead to the deduction of certain essential consequences of each theory which must be the counterparts of the facts if the corresponding theory be correct, and yet which have not, as far as one may judge by published articles and reports, been consciously enough in the minds of those who proposed or adopted a certain theory to lead them to state whether these consequences are confirmed or contradicted by the facts. Thus certain observers of uplifted reefs, who have preferred the theory of still-standing outgrowth to the theory of subsiding upgrowth, have not reported whether the uplifted reefs that they have observed possess a structure of one kind or another; they have not even stated whether the reefs rest on a non-dissected volcanic slope, as the theory of still-standing outgrowth demands, or whether they lie upon an eroded volcanic slope, as the theory of subsiding upgrowth equally demands; and thus they have failed to present to their readers some of the critical tests by which the rival theories can be discriminated. Other observers of barrier reefs have not, whatever theory they adopt, reported whether the embayments of the central island occupy valleys of normal erosion or graben due to volcanic engulfment. In the absence of statement concerning these critical facts, safe judgment cannot be reached.

The evident moral of all this is that an outline scheme, which in its first invented form gives a general explanation for the things that it was invented to explain, must be systematically extended by the mental process of deduction until it includes all the imaginable details in the series of events that it involves; in short, until it shall give a complete historical account of all correlated phenomena within the region under investigation. Only after the outline scheme is thus filled out will an observer on the ground be able to test it by comparing its unexpected consequences with previously unnoticed facts. Indeed, only after the observer is thus led to direct his attention to the occurrence or non-occurrence of certain significant facts will he be able to certify whether such facts occur or not; "for there," as Playfair so well said, "the clue of theory is necessary to direct the observer:"—not to direct him to see the

desired facts whether they exist or not, but to direct him to see whether or not they do exist. This moral is indeed so evident a corollary of the method of investigation here adopted, that its omission, by many students of coral reefs, emphasizes the conclusion above noted, to the effect that for them some other method of investigation must have seemed sufficient. Indispensable as the method of investigation here outlined is to those who follow it, familiar as it is to those who know it, it is perfectly clear that not this, but some other method, has been employed by all students of the coral reef problem.

Summary of Results. Ignorance concerning important structural details of most coral reefs will probably continue for centuries to come. Even if a few selected reefs are perforated by many deep borings, so that their structure is well determined and their origin demonstrated, it will not follow that all other reefs are of the same structure and origin. Hence all that can be hoped for in the way of a solution of the coral reef problem—or of any similar problem—is a high probability of correct explanation, in which the inferences that are strongly supported by closely studied reefs may be fairly extended to other similar but less studied reefs. In a comprehensive theory which embraces fringing reefs, uplifted reefs, barrier reefs and atolls, it may well be that the evidence on which the finally accepted theory is supported is based more largely on uplifted reefs and barrier reefs than on reefs of the other two classes. With regard to the origin of one of these classes, fringing reefs, there is general agreement, for all theories begin with fringing reefs; but the origin of the other class, atolls, must remain only indirectly inferred. At the same time, however successful any one theory may be, it would be unreasonable to exclude all operation of other less successful theories, which may in special cases provide supplementary explanations for peculiar features. Furthermore, however many subordinate modifications are introduced, they will not lessen the value of a primary principle, but merely embroider secondary complications upon it, in the same way that the attractions of the planets cause minor perturbations in the earth's orbit, of which the general form is controlled by the dominating attraction of the sun.

Although atolls are more numerous than barrier reefs, the two forms appear to be so related to each other, and both appear to be so closely related to fringing and to uplifted reefs, that no theory can be accepted for any one of these forms which does not, under proper conditions, reasonably account for the others as well. As

to fringing reefs there is no difficulty: they are begun by colonizing coral larvæ on any new shore line where proper conditions for coral growth are offered. As to uplifted reefs, it is only necessary to add elevation to the previously acting processes of accumulation; but so few details of their structure have been reported that proof of their origin, other than as narrow fringing reefs, is not at present forthcoming.

As to atolls, so much of their under-structure is unknown that full confirmatory evidence of any theory of their origin will be difficult to secure: conclusions regarding them will be derived chiefly from reefs of other kinds. Apart from the close study of uplifted reefs and from deep borings which might reveal the structure of large barrier reefs, it is chiefly from the central islands within reefs of the latter class that independent evidence may be secured, confirming or contradicting any theory by which such reefs are to be explained; for no general theory of coral reefs can be accepted which does not account for the associated features of the central islands within barrier reefs; particularly for the features of their shore lines, and for the biotic relations of neighboring islands, as well as for the structure of the reefs themselves.

Only two of all the theories above considered can account for the embayed shore lines of the central islands and for their biotic relations as above indicated. The eighth theory, which relates a recent upgrowth of new barrier reefs on the truncated platform of earlier formed reefs to the rise of sea-level after its depression during the glacial period, will account either for narrow embayments between tapering spur ends on the central islands or for wide embayments between cliffed spur ends, and also for recent biotic relations of neighboring islands that are separated by shallow water passages: but it will not account for wide embayments between tapering spur ends or for biotic relations of remote origin on neighboring islands separated by deep-water passages. On the other hand, the sixth theory, which relates the upgrowth of barrier reefs to a general subsidence of their foundation, will very satisfactorily account for wide embayments between tapering spur ends and for biotic relations of remote origin on neighboring islands separated by deep-water passages. Hence the theory of subsidence appears to be the most successful of all the theories that have been here discussed. It may be modified so that, while retaining the dominant factors of the original theory, it will include certain subordinate factors derived from other theories, such as outgrowth on certain islands during temporary still-stands and

abrasion on certain islands at a lower level during the glacial period; but subsidence will still remain dominant. Surely a pause in a long subsidence, and the accompanying outgrowth of a reef with the correlated forward growth of deltas in the previously drowned valleys on a single island, would not invalidate the generality of subsidence elsewhere indicated by the absence of deltas and the occurrence of unfilled embayments in the central islands of nearly all barrier reefs. Oscillations of sea-level must have occurred in consequence of changes of climate during the glacial period, and their effects must be looked for; but in view of the facts as now reported, the oscillations are best regarded as small changes superposed on a dominating subsidence. The abrasion of a platform around a volcanic island and the subsequent growth of a veneering reef on the outer border of the platform is easily conceivable, but it does not seem to have been an actual process on islands that are not rimmed around by cliffs. The development of a new barrier reef by the wearing down of a previously formed and uplifted mass of coralline limestone sets the origin of such a mass back into an earlier period of time, when, if it surrounded an eroded slope, its formation in the sea must have been preceded by submergence of the eroded land surface: but more must be learned of the structure of uplifted coralline limestones on the flanks of volcanic islands before their origin can be safely determined. Subsidence still seems to be the dominating factor.

The home study of coral reefs—or rather the home study of the reports of observers who have seen coral reefs—therefore reaches, as here set forth, the same general conclusion that has been reached by several investigators who, living in Australia or New Zealand, recently have had occasion to examine the not distant reefs of the Pacific; for these investigators also attribute a dominating importance to subsidence.

The home study of coral reefs has, however, a special bearing to which reference has not yet been made: it is the best preparation that one can make for the observational study of coral reefs; and it is chiefly with that object that the home study of coral reefs here set forth has been undertaken.

PRELIMINARY REPORT ON THE RECENT VOLCANIC ACTIVITY OF LASSEN PEAK*

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CONTENTS

Introduction

The recent formation of a new crater on the old cone of Lassen Peak is, so far as the writer knows, the first recorded instance of undoubted volcanic activity actually witnessed within the limits of the United States, if territory not contiguous be excluded. It is not surprising, therefore, that both popular and scientific interest have been greatly aroused as to the nature and extent of the real changes which have taken place. At first it was difficult to secure reliable reports, for the region about the mountain is sparsely settled, and this year, on the date of the first eruption, May 30, the snow was still very deep, obscuring all roads and trails as low down as the six thousand-foot contour line. On account of the unusually late season, the summer influx of cattlemen, lumbermen and campers had not yet begun; probably the nearest occupied house was at least eight miles distant in an air line from the mountain top. The inhabitants of the neighboring region were unfamiliar with volcanic phenomena and very naturally observations from stations ten to fifty miles distant resulted in the first reports being conflicting and confusing.

Considering all these circumstances, it seems advisable to issue

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this preliminary report even though at this date it is necessarily incomplete, and even though the probability may be strong that the eruptions have by no means ceased.

Geographic Relations

Lassen Peak is in the southeastern part of Shasta County, in northern California, about two hundred miles from San Francisco. According to the Lassen Peak topographic sheet (a reconnaissance map surveyed in 1882-84), the mountain is 10,437 feet in elevation and is approximately in latitude 40°30′ N. and longitude 121°30′ W. The immediate region lies on the extreme southwestern edge of that great Tertiary lava flow some 250,000 square miles in extent which covers not only northeastern California but portions of Oregon, Washington, Idaho, and Nevada.

In general, geographers consider Lassen Peak as marking approximately the southern end of the Cascade Range, and as being the last of that series of great volcanic cones of which Rainier, Adams, Hood, Three Sisters, Pit, Mt. Mazama, and Shasta are familiar examples. To the southeast of Lassen is the topographic gap of the Feather River separating the Cascade Range from its correlative, the Sierra Nevada, which extends four hundred miles farther to Tehachapi Pass but whose lofty peaks owe their height primarily to uplift rather than to volcanic upbuilding.

Past History

The southern fifty miles of the Cascade Range extending northwesterly toward Shasta from the North Fork of the Feather River is a great volcanic ridge, about twenty-five miles wide, studded with numerous minor volcanic cones and culminating in Lassen, the dominating peak, guarded by a half dozen other major cones which rise to heights varying from seven thousand to nine thousand feet above the sea. Past volcanic phenomena of the Lassen Peak region in recent geologic time have been made familiar to readers through J. S. Diller's well-known report,[1] which describes with considerable detail the Cinder Cone, ten miles northeasterly from the main peak, from the base of which the latest lava flow issued. Until the present outbreak, despite our knowledge of the Cinder Cone lava flows, it has been tacitly assumed in physiographic literature that Lassen Peak belonged to the class of extinct volcanoes, although the following statement by Diller in the folio just quoted shows clearly that twenty years ago he recognized the possibility of renewed eruptions.

[1] Lassen Peak Folio, U. S. Geol. Survey, 1894.

"The volcanic action which has built up Lassen Peak with its many associative cones is comparatively recent. It began at the close of the Ione epoch and occurred most violently at the time the Sierra Nevada was upheaved, but it has continued spasmodically to the present time . . . . The latest volcanic eruption in the Lassen Peak district, and possibly the latest in the United States south of Alaska, occurred at the Cinder Cone about two hundred years ago. Some of the trees killed at the time are still standing. The lava, although very viscous, spread more than a mile from the vent and formed a huge tabular pile which extends across a little valley. The lava dam thus formed developed Snag Lake, which contained stumps of some of the trees drowned at the time the lake originated.

"That volcanic activity is not yet extinct in the Lassen Peak district is shown by the presence of numerous solfataras and hot springs. At Bumpass's Hell, near the southern base of the peak, there are boiling mud pools and vigorous solfataric action. Near by, at the head of Mill Creek, the sulphur deposited by such action is so abundant that attempts have been made to mine it. Similar phenomena occur in Hot Spring Valley and at Lake Tartarus and the Geyser, near Willow Lake. The Geyser is much less vigorous than formerly, and now the column of water rises scarcely a foot above its pool."

Present Volcanic Activity

The present volcanic activity of Lassen Peak began the latter part of May. Prompt investigation of the real condition of affairs is due to the fortunate fact that the mountain is included in the Lassen Peak National Forest and that the United States Forest Service[2] had built a fire lookout station on the topmost crag of Lassen Peak itself. The headquarters of the Forest Supervisor, Mr. W. J. Rushing, are in Battle Creek Meadows, near Mineral post office, a little more than ten miles in an air line from the top of the mountain. The lookout house on Lassen and the other stations also are connected with the Supervisor's headquarters by the government telephone lines which extend to the town of Red Bluff, nearly fifty miles to the westward, giving direct communication with San Francisco. When the eruptions began the fire lookout station on Lassen had not as yet been occupied for the summer season of 1914, but it was the property of the Forest Service and a station of special importance. It will be seen that the

[2] The writer is glad to express his appreciation of the assistance and courtesies extended him in connection with his field work not only by District Forester DuBois, of San Francisco, and Supervisor Rushing, of Mineral, but also by various members of the staff in each place.

interests and resources of the Forest Service as indicated above were such that reports of volcanic activity on Lassen were investigated at once and definite records kept of the reports brought in to headquarters. The newspapers of June 2 gave to the general public its first intimation of the volcanic outbreak. As Lassen is visible from fifty to sixty miles in all directions to places favorably situated, the reports of the same eruption seen from different points of view were frequently contradictory. In some of the accounts flames and molten lava were graphically described and such startling reports were either still further exaggerated or the entire occurrence unduly discredited according to the temperament of the reader. The continuation of these reports finally convinced the public that unusual phenomena of a volcanic nature were taking place on the mountain, but it was a difficult task to sift and correlate the various accounts published. Earthquake shocks were reported in some of the earlier eruptions, especially from the region to the eastward of Lassen Peak. Later eruptions were apparently entirely free from seismic disturbances. The following extracts from the report of Forest Supervisor W. J. Rushing to the District Forester at San Francisco, made June 9, give the best summary yet available of events up to that date.

LASSEN—SUPERVISION.

MINERAL, CAL.,
June 9, 1914.

District Forester, San Francisco, Cal.,

DEAR SIR:—Such wild stories are being circulated concerning Mt. Lassen that I am sending you the results of our observations to date.

Saturday, May 30, the first outbreak occurred at 5 P. M. This was witnessed by Bert McKenzie, of Chester, who was looking directly at it when it occurred. Ranger Harvey Abbey investigated it Sunday, May 31, finding a hole 25 x 40 feet in size and of unknown depth. Sand, rocks as large as a sack of flour, and mud had been ejected. The heavier material was thrown over an area three hundred feet across, while the ash, or cement-like material, was scattered over an area one-quarter mile across. . . . No molten material was thrown out at all.

8:05 A. M., June 1, a second outburst occurred, throwing out large quantities of the same material. Some boulders weighing all of a ton were thrown out. The vent was enlarged to 60 x 275 feet. . . . Boerker, Abbey, and Macomber went up June 4, remained on top at the lookout house over night, and came back June 5.

June 8 heavier volumes of steam were noted, and at night apparently another eruption took place, throwing out more ashes or fine material, which could be seen on the new snow.

Heavy volumes of steam are coming out of the vent to-day. We have watched it carefully and at no time have we been able to see any flame or indication of fire. . . .

The vent is about one-quarter mile from the fire lookout house, and if it continues eastward, as it has so far, it will finally break out on the east side.

No damage has been done to the house yet, and if the action does not become more violent will not prevent a lookout occupying it.

Very truly yours,
(Signed) W. J. RUSHING,
Forest Supervisor.

Mr. Ben Macomber, one of the party mentioned in the report above as spending the night on the mountain top, has given the following description of the crater as it was after the early eruptions:

When I saw the new crater on Lassen on June 4th and 5th the vent, by an engineer's tape, measured 275 feet long. It was then in one of the pauses between the heavy explosions. Thick volumes of steam, laden with sulphur smoke, were rising, and cracks were appearing in the ground. From three different places on the edge I looked down into the crater. Sixty or seventy feet down a pile of rocks was visible in the center of the vent, but at either end was a huge dark hole from which the steam clouds poured. The walls were absolutely perpendicular and around the top were hung with huge icicles formed by the condensation of steam in the chill air of the peak.

On the west side of the crater everything was buried beneath a heavy fall of light gray ash, into which we sank over our boot-tops. So light was this rock powder that it flew into the air at every step. On the east side the same material seemed to have been thrown out in the form of mud and lay frozen hard as rock. What little snow remained near the crater was buried under a layer of stones and boulders. The larger boulders had sunk down into the snow, creating many treacherous pits.[3]

EXPERIENCES NEAR THE CRATER DURING ERUPTIONS

An interesting series of eruptions occurred June 12, 13, and 14. On Friday, the 12th, Forest Ranger Abbey and a party of five were "climbing upward half a mile from the crater, when with a great roar the mass of ashes and boulders shot into the sky above." Immediately stones began to fall about them, and three hundred-pound boulders began to drop a short distance above and bound down the mountain side toward them. The party ran to shelter behind a point of rocks on the ridge. Milton A. Ayres, the San Francisco moving picture operator, alone faced the storm. Setting up his machine on a boulder, he began to turn the handle. That night he told the story of his experiences at the volcano.

We had no warning. The roar and the uprush of the black mass above were simultaneous. The rocks began to fall on the mountain side; the gases did not come our way much, as the wind drove them to the east, but we got some strong whiffs of sulphur smoke. For the same reason little ash fell where we were. . . . .

[3] *San Francisco Chronicle*, June 28, 1914.

> Later we went on to the summit, reaching it at 6 P. M., two hours after the eruption began. We found the whole mountain top strewn with great boulders and heavy ash. No one could possibly have lived at the top while the outburst was on. We climbed up to the shelter house, where we had expected to spend the night, and found it in ruins. Boulders had crashed down through it and splintered the building to kindling wood.[4]

On the way down the next morning another eruption took place at 6 A. M., lasting thirty minutes, during which ashes fell at the headquarters of Forest Supervisor Rushing.

The eruption of June 14, the third day of this series, was the heaviest yet reported. The only injuries suffered by visitors to the crater occurred in the outburst beginning about 9:45 A. M. On that morning a party of eight were climbing the mountain from Manzanita Lake.

> They reached the crater in safety, looked down upon it, and, noting the heavy outpouring of steam and smoke that boiled up between the three peaks that mark the ruined walls of the ancient crater, decided to get away as quickly as possible. They were too late; hardly had they gone a quarter of a mile from the crater when the black mass of rock and ash rushed up from the crater with a mighty roar and stood high above them. They ran in terror before the awful threat, but there was no refuge. With a crash the hail of rock fell upon them. At the same moment the storm of ash came down with midnight blackness. As the men ran down the slope they lost each other in the darkness. When the survivors came out of the storm and met below the line of rock and ash four men were missing. For two hours explosion followed explosion in one continuous crash.

In the rest of the dispatch one of the party, Lance Graham, was reported to have died of his injuries. Later reports stated that he was found unconscious, and was later left for dead, but he was finally taken down the mountain side and is now reported convalescent. He was severely injured, the bones of the shoulder being broken and the flesh badly bruised. The other men temporarily lost finally reached camp in safety. Considering the difficulty of getting accurate accounts, especially when in most cases there necessarily was repetition in transmitting the news, it is not surprising that the first accounts contained many inaccuracies. The portions quoted were selected because subsequent events showed them to be practically correct, although an inspection of Figure 4 does not justify the statement that the fire lookout house was splintered to kindling wood. The quotations, however, undoubtedly fail to give a correct impression of the grandeur of the phenomena or of the terror which they must have inspired in the observers within the danger zone.

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[4] *San Francisco Chronicle*, June 14, 1914.

The best pictures of Lassen Peak taken during an eruption are possibly those obtained on the morning of June 14 by Mr. B. F. Loomis. Four of these photographs are reproduced in Figure 7, showing successive phases of the eruption. A letter from Mr. Loomis came after this paper was finished, but the major part of it is inserted here because of its great interest, even though some newspaper accounts of the same events have already been given.

VIOLA, SHASTA CO., CAL.,
July 13, 1914.

Mr. R. S. Holway, Berkeley, Cal.,

DEAR SIR:—Yours of the 3rd inst. is just received, in which you ask me to say a few words in regard to the eruption of Mt. Lassen. It affords me pleasure to comply with your request, as I know the information will be used for educational purposes.

Viola is situated about ten miles west of Mt. Lassen, and as I have climbed to the top of the mountain three times since the first eruption on May 30th I am fairly familiar with conditions as they exist there.

We had been camped on the road two days waiting for an eruption to occur, with camera focused and trained on the mountain all ready to begin taking pictures at a moment's notice. Mrs. Loomis enjoys landscape painting, and to get the colors properly it was necessary for her to witness an eruption. About 9:45 Sunday morning, June 14, our vigilance was rewarded with success. I saw the smoke ascending from the crater the moment the eruption began. I ran to the camera, put in a plate holder and exposed, getting what we call photo No. 1. Then I changed the plate holder and exposed again as quickly as possible, getting photo No. 2. At this time a wonderful phenomena occurred. The heavy ashes contained in the column of smoke, its momentum being spent, began falling downward and flowed down the sides of the mountain, then rolling up in immense clouds of black smoke. This is slightly noticeable in photo No. 2. At this juncture I exposed again, getting photo No. 3. The wind was from the south, which blew the smoke to the left from my position and away from the top of the butte; then another cloud shot upward, when I exposed again, getting photo No. 4. These clouds of black smoke were so dense that they seemed to stand up like a mountain of granite in a solid mass. The sight was fearfully grand. The cloud was moving rapidly toward the north, when I soon got photo No. 5. These first photos were taken with a telo-photo lens, 14-inch focus, and later, when the cloud of smoke was all spread out, I got photo No. 6, this being made with the combined lens with 8½-inch focus, the size of the plates being 6½ x 8½.

This eruption of June 14th was the ninth eruption, and the time between photos No. 1 and No. 6 was about twenty minutes. These eruptions sometimes appear as a puff of smoke and ashes, and at other times they continue for about half an hour. The distance from my viewpoint to the top of Mt. Lassen is a trifle over six miles, according to the geological survey.

But in the midst of my enthusiasm in making the pictures I could not help thinking of those men who I knew must be near the mountain. Were they safe? Mr. R. E. Phelps and his mill crew, ten men in all, were camped at Manzanita Lake the night before. They struck camp early in the morning to climb the

Fig. 1—Lassen Peak from the southwest. This view, showing the upper fourth of the mountain, was taken from a peak about three miles distant and approximately 8000 feet in height. The two minor peaks at the top are the ends of two eroded ridges, the remnants of the walls of the ancient crater.

Fig. 2—Limit of falling ash not wind-borne. The viewpoint was at an elevation of about 8500 feet on the south slope of Lassen Peak. A slight fall of new snow partially obscures the ash. June 28, 1914.

mountain to look at the crater. They went up on the north side right under where the heaviest smoke and ashes fell. Another party of five men also left the lake at 8 o'clock on the same mission. Mr. Phelps' party had just reached the rim of the old crater and sat down to rest a short time, watching the smoke from the crater, when the eruption began. Without any warning or explosion that could be heard, a huge column of black smoke shot upward with a roar, such as would be caused by a rushing mighty wind, and in an instant the air was filled with smoke, ashes and flying rocks from the crater. They all ran for their lives. Mr. Phelps hid under an overhanging rock, which sheltered him from the rocks which brushed past him as they fell. Lance Graham was a few feet away and was struck by a flying rock, which cut a great gash in his shoulder, piercing the thoracic cavity, and broke his collarbone. He was left on the mountain for dead, for a time, but was afterward removed with great difficulties, and is now recovered. Jimmy Riggins, another of their party, ran down the mountain and, coming to a snowdrift, slid down the mountain like a shot. The cloud of smoke kept pace with him, and when he reached the bottom of the snowdrift he found a clump of bushes and, diving into it, buried his face in the snow to keep out the blinding smoke and ashes. The smoke is described as causing the blackest darkness, black as the darkest night. If it had lasted much longer some of them would have been smothered.

One peculiarity is that all the rocks and ashes were cold, or only lukewarm. Had they been hot these men would have been burned to death. Later I learned also that the rocks which fell on the snowdrift inside the south rim of the crater are lying on top of the snow where they fell, the snow being frozen hard when they fell, but they would have melted their way to the bottom had they been hot. This snowdrift is about 600 feet south from the new crater and there are probably a thousand rocks lying on top of the snow where they fell. This snow is covered with about three inches of ashes, which turn black when wet. It is seen in the foreground in my photo of the crater. . . .

Trusting that this brief description will be of service, I am

Very truly yours,

B. F. Loomis.

Condition of the Crater June 26 and 28

The writer's observations were made in the interval from June 21 to 29, between which dates no eruption took place. On the 21st the mountain was approached from Mineral by way of Soupan Springs. During the day a continuous thin jet of steam was being emitted from the crater, but the camera failed to show the steam in the view taken from the peak just north of Soupan Springs, Figure 1. This view shows the top of Lassen as two minor peaks. On reaching the top these two minor peaks seen in perspective from the southwest are found to be two much eroded ridges which are undoubtedly remnants of the ancient crater walls.

From June 23 to 25, rainstorms, with snow on the higher levels, prevented a visit to the crater with any possibility for photographic work. On Friday, the 26th, and Sunday, the 28th, the sky was

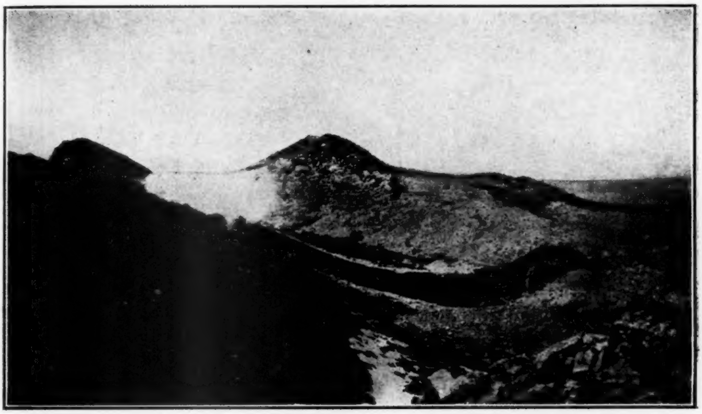

FIG. 3—The new crater as seen June 28, 1914, from the south wall of the old crater. Occasionally puffs of steam came from the right-hand end of the new vent. By pacing, the length of the crater was estimated to be approximately 400 feet.

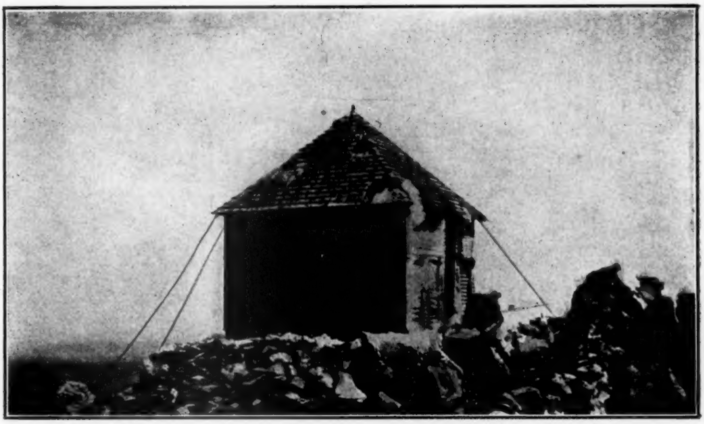

FIG. 4—The fire lookout station of the U. S. Forest Service on June 26, 1914. The holes in the roof were probably made during the eruption of June 14. The house is built on a crag located at the right on the extension of the ridge showing in immediate foreground in the figure above.

clear, and on both those days the actual crater was visited and photographed from various points of view. Both trips were made from the hotel at Morgan as a base. The ride on horseback to the foot of the volcanic cone proper at that time took almost four hours, the latter half being over snow from ten to twenty feet deep. The new crater has frequently been described as being located on the south slope of the north peak. North Peak, however, is merely the northern portion of the walls of the ancient crater. The relations of the new opening to the old volcano are better appreciated by describing it as an opening not in the center, but on the north side of the bowl of the old crater. The central depression of the old crater is probably over three hundred feet below the remaining points of the old rim. The wall of the old crater has been deeply breached both on the east and on the west, and the melting snow in the depression now drains westward, although there is not enough surface water to make any regular channel. The volcanic dust or "ash" from the different eruptions has been reported as falling from ten to twenty miles from the peak, the amount and direction evidently varying with the wind. Figure 2 shows that the limit of the heavy fall of ash not wind-borne was quite definitely marked and was probably within a circle of a half mile. It was not, however, a uniform circle. In making the ascent on June 26, instead of the regular trail a more easterly route was taken, leading up the southeasterly ridge directly to the fire lookout station. This ridge, which lies in the general direction of the longitudinal opening of the crater itself, was found to be much more heavily covered with ash than the regular trail. While the main outburst was directly upward in the eruption shown in Figure 7, irregular streaks of ash such as the one just noted prove that there were minor outshoots of volcanic dust in various directions. Reports of the distance to which stones were thrown seem to have been based upon their being found resting upon the surface of the old snow, but the fact that stones are constantly being dislodged from the cliffs by ordinary weathering processes and are rolling down the mountain side shows the need of additional criteria. To avoid mistaking such stones for those thrown through the air by eruption, careful search was made on level patches of the old snow so located that stones could not well roll down upon them. Wherever such level surfaces were found there was no evidence of ejected stones falling a much greater distance than the lookout house.

The new route taken June 26 in climbing the last two thousand feet of Lassen presents some advantages in studying the mountain

FIG. 5—The northwesterly end of the crater on June 28. Whenever the steam was blown aside, a crack was visible extending in the line of steam jets.

FIG. 6—The southeasterly end of the crater on June 28. The crack leading to the right (partially filled in) extends in the same direction as the general trend of the new crater. See also plate 34, figure 1. The elongated crater and the cracks suggest that the new vent may be an opening along a fault line.

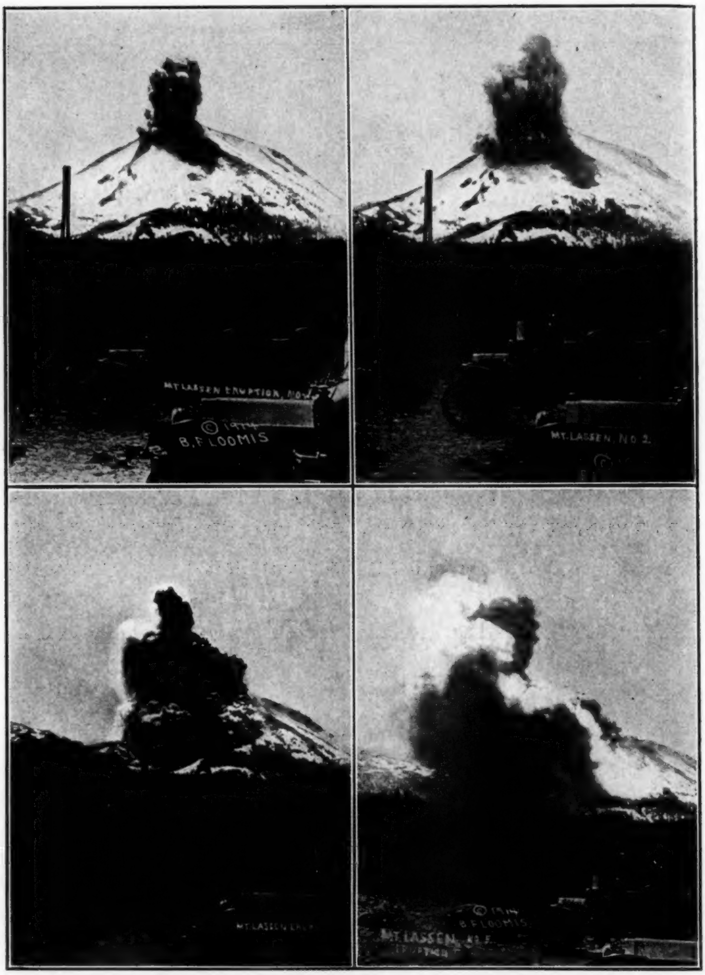

Fig. 7—The Eruption of June 14, 1914.
This series, showing four stages in the eruption beginning at 9:45 A.M., was obtained by Mr. B. F. Loomis, of Viola, from a point about six miles to the northwest at an elevation of nearly 5000 feet. The time interval represented by the entire plate in about fifteen minutes.

in relation to its volcanic activity. To the eastward can be seen the lava field of Cinder Cone and some half dozen other cones, several of them with the craters still well preserved. On reaching

the narrow ridge which leads immediately upward to the fire lookout station, directly below to the northward there is seen an area of barren, burnt-looking rocks suggesting a local outpouring of lava in geologically recent time. The heavy deposit of recent ash through which one walks for the last twenty minutes extends but a moderate distance on either side of the ridge, indicating that this route to the top is directly in the line of fire of the crater above. Nearing the top, the crag upon which the Forest Service station is built becomes so steep and rugged that the final climb is made without any glimpse of what is ahead. As the last rocks are scaled and one stands on the few feet of space by the little frame building bound down to the crag by wire cables, there suddenly yawns below the climber the bowl of the ancient crater, and he looks directly into the irregular naked chasm of the new vent torn in the opposite slope. It is impossible for a camera with its narrow field of view to give correct impressions of the topographic conditions of the mountain top. The observer standing upon that sharp rocky pinnacle is conscious of the steep slopes behind him and, although he narrows his vision to the new crater steaming below, he sees subconsciously the surrounding ragged edge of the bowl of the ancient crater.

Descending into the irregular basin, the new vent was photographed at closer range from various directions. No appreciable change occurred between June 26 and June 28, except the rapid disappearance of the new snow as a result of the warmer weather. The northwesterly end of the new crater, Figure 5, was of most interest because of escaping steam. On close approach the sulphur fumes became oppressive and yellow sulphur deposits near the vents were distinctly noticeable. The crater was apparently being extended longitudinally along cracks at either end. The northern wall showed also a transverse crack running back from the vent more than a hundred feet, Figure 6. The depth of the crater did not seem to be over eighty feet, but the continually caving sides suggested that the present bottom is but piled-up debris. No suggestion could be obtained of the depth of the holes from which steam was escaping. By pacing a line parallel to the side and some fifty feet distant the length of the crater on June 28 was estimated at somewhat more than four hundred feet. This estimate is less than that given by some observers, but agrees closely with that made by Mr. Diller on June 20.[5]

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[5] *Science*, Vol. 40, N. S., p. 50.

Evidences of Heat

Reports that the whole upper part of the mountain down to the 8500-foot level, approximately, had been snow-covered and that the snow had been melted by volcanic heat are entirely erroneous. Snow covered by the ash was still to be seen close to the crater and in considerable quantity on June 28. The new snow of June 23-25 was visible in patches on top of the ash, yet by digging through that and through the layer of ash below the old snow was found underneath. In fact, there was no evidence of heat on the mountain top other than the escaping steam. The ejected rocks seemed identical with the old lava rocks still in place on the mountain top. Naturally those ejected from a hundred or more feet below the surface would not bear indication of surface weathering, but there certainly was no rock found having the appearance of being recently fused.

Later Eruptions

The writer left Morgan Springs on June 29, there having been no eruption during his stay, unless minor ones took place at night. Heavy eruptions took place during the next three days and were briefly described as follows by Mr. Rushing in his report dated July 1:

> June 30, 11:06 A. M., lasted until 12:14 A. M. Column ascended 2800 feet.
>
> July 1, 5:30 A. M., lasted until 6:31 A.M. Very heavy eruption. Column ascended over 3000 feet. Heavy volumes of volcanic dust thrown out. No lava, flames, or earthquakes were noticed.
>
> Many wild rumors of forest officers and private individuals being injured or lost are in circulation, but there is no foundation to them, although many people are taking serious chances by visiting the crater.

Since that time until the date that this paper was transmitted for publication there have been reports of other outbursts, as may be seen in the list of eruptions appended.

List of Eruptions, May 30 to July 15, 1914

The greater portion of this list was prepared at Mineral under the direction of Forest Supervisor Rushing, but as additions have been made to bring it up to a later date he should not be held responsible for inaccuracies. Reports of eruptions at night and in cloudy weather are naturally most open to doubt.

No.	Date	Time	Character of	Duration	Size
1	Sat., 5/30	5:00 P.M.	Heavy	10 min.	25 x 40
2	Mon., 6/1	8:00 A.M.	Heavier	15 min.	275 x 60 60 ft. deep
3	Tues., 6/2	9:30 A.M.	Very heavy	30 min.	
4	Mon., 6/8	4:30 P.M.	Heavier	40 min.	
5	Tues., 6/9	10:30 A.M.	Heavy, steam darker	30 min.	
6	Fri., 6/12	3:45 P.M.	Heavy, steam very dark	50 min.	400 x 100
7	Sat., 6/13	6:00 A.M.	Ashes fell at Mineral, heavy	30 min.	
8	Sun., 6/14	6:00 A.M.	Unconfirmed, reported by Red Bluff	?	
9	Sun., 6/14	9:43 A.M.	Altitude smoke 2500 ft., heaviest yet	30 min.	
10	Sun., 6/14	6:45 P.M.	Medium	15 min.	450 x 125
11	Fri., 6/19	8:15 P.M.	Altitude smoke 2000 ft., medium	15 min.	600 x 150
12	Mon., 6/29	3:00 A.M.	New snow covered by layer of ash	?	
13	Tues., 6/30	11:06 A.M.	Heavy, series of slight eruptions followed first, alt. 2800 ft.	40 min.	
14	Wed., 7/1	5:30 A.M.	Heaviest yet, alt. smoke 5900 ft., as per calculations	50 min.	
15	Thur., 7/2	6:50 A.M.	Very heavy	30 min.	
16	Mon., 7/6	3:30 A.M.	Reported by Red Bluff, heavy, steam and smoke from entire length of crater	30 min.	
17	Sat., 7/11	6:35 A.M.	Light	30 min.	
18	Mon., 7/13	3:00 P.M.	Light	90 min.	
19	Tues., 7/14	6:00 A.M.	Light		
20	Wed., 7/15	12:05 P.M.	Heavy		

Summary

Lassen Peak, an old volcanic cone in a region where a lava flow occurred some two hundred years ago, has exhibited true volcanic activity during the past six weeks. In the bowl of the much eroded old crater a series of steam explosions have opened a new vent, and from it stones have been thrown over an area more than one-half mile in diameter, and ejected volcanic ash has been wind-borne in sufficient quantities to make a perceptible deposit at a distance of fifteen to twenty miles. No freshly molten lava has been seen and no heat has been noticeable, except that of the escaping steam. Sulphur fumes and slight sulphur deposits near the vent have been noticed by nearly all observers.

The source of the heat causing the explosions of steam is a matter of conjecture. It may of course be due to an ascending column of lava working its way up the old vent, but such suggestions are merely speculations, as would be any opinion as to the future activity of the volcano.

July 16, 1914.

MODERN KOREA

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Department of Geography and Industry
University of Pennsylvania

Physical Configuration

Position. Korea is a peninsula in northeastern Asia. Its nearest neighbors are the Shantung Peninsula in China on the west; Manchuria and Siberia, to which it is joined, on the north; and Japan on the east and south. The Yellow Sea separates Korea from China, but the distance between the nearest ports of each country is only 270 miles, while land projections bring the two regions even closer together. Japan faces eastern Korea across the Japan Sea, but on the south Korea is almost within sight of Japan, for the Korean Straits are but 120 miles across at their narrowest portion. An outlying island belonging to Japan (Tsushima) and lying in the Korean Straits is actually visible from Korea in clear weather. For these reasons Korea, although a peninsula, is close to the lands adjacent to her, and acts as the link which binds them together.

If Korea could be moved laterally without changing her north and south position her northernmost extremity would touch the northern boundary of California, her most southern port would be in the neighborhood of Fresno, Cal., and her capital, Seoul, would coincide with San Francisco. A second move would place the northern points at Chicago, Ill., the southern at Chattanooga, Tenn., and the capital at St. Louis. If we shift the position a third time, Providence, R. I., would mark the north, Wilmington, N. C., would be at the site of Korea's capital. In Europe, Rome, Italy, would overlap Korea's northern border, the southern would be in line with the city of Tunis in northern Africa, and the capital of Korea would be opposite Seville, Spain. In other words, Korea is 600 miles long, extending between the 34th and 43d parallels. Korea's 135 miles of width corresponds to the width of California along the Mexican border, or to Northern Michigan, or Florida, or Italy.

In general appearance and size Korea is not unlike Italy, or resembles a very much enlarged picture of New Jersey. If Florida

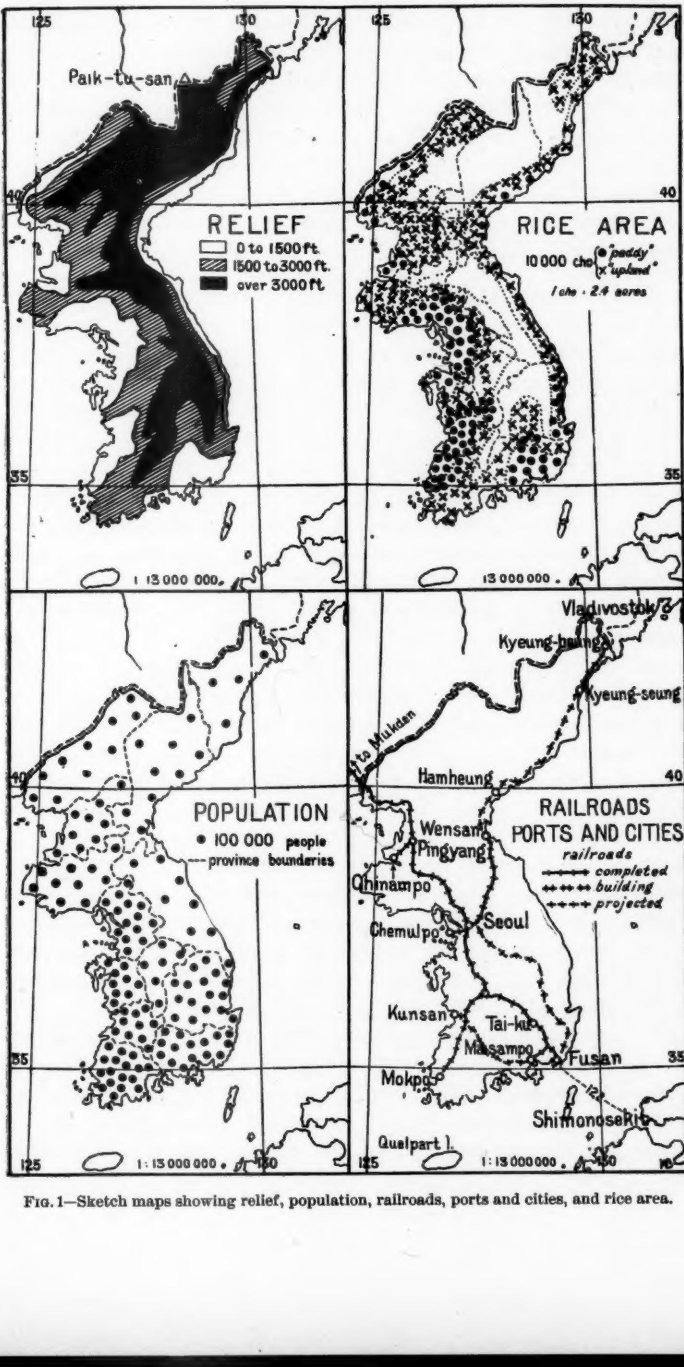

FIG. 1—Sketch maps showing relief, population, railroads, ports and cities, and rice area.

could be reversed so that its northwestern projection would become a northeast extension and then the whole peninsula lengthened by a third it would bear a striking similarity to Korea. The area of Korea, 82,000 square miles, is a little more than half that of California. On the other hand, Illinois is only two-thirds as large, and all New England about three-fourths. England and Scotland together are about equal to Korea, while Italy is one-fifth larger. Korea comprises about one-third of the Japanese Empire, of which it is a part.

Topography. At first glance Korea appears to be all mountains, and, in fact, they cover five-sixths of her territory. The mountains are highest and most completely occupy the country in the north. The highest point, almost in the center of the northern boundary, called by the Koreans Paik Tu San, which means The Long White Mountain,[1] is 8,700 feet in altitude. From this elevation the mountains gradually diminish in height southward, but extend nearly to the end of the peninsula. Beyond the peninsula the system can be traced in a large number of islands that girdle the southern and southwestern shores of the mainland. The backbone of the mountain system is near the eastern coast. On the east the slope is always steep, often abrupt and sometimes precipitous. Therefore on this side streams are short, shallow and rapid, and the coastal plain is a mere fringe. There is only one large river, the Naktong (in the extreme southeast), but even this is navigable only for a short distance for small boats. The western slope is far more gentle, but even it is fairly steep. Consequently in all Korea there are many small quick-flowing streams, but only a few rivers. On the western flank of the mountains, four streams[2] reach the dignity of rivers and are navigable above their mouths for small boats. For the most part the innumerable brooks are useless for power purposes due to the fact that seven-eighths of the rain falls during one short season, when the watercourses are torrents, but throughout the remainder of the year they have a greatly diminished volume. There is only one hydroelectric plant in the entire country.[3]

The main axis of the mountain system does not follow the general north and south trend of the peninsula, but is at an angle N.E.–S.W. across it, with many spurs projecting westward. This favors the distribution of rainfall throughout the whole country during the summer rainy season, for the rain-bearing winds blow

[1] So called on account of its snow cap. [2] Tumen, Yalu, Ta dong, Han. [3] At Gensan.

from the southwest to the northeast. On the other hand, the cold winds from the ice-bound interior of Siberia have free access to all the north and northeastern parts of Korea in the winter. The southern portion is tempered by the all-surrounding water and especially by the nearby presence of the Yellow Sea warmed by the Japan Current. As a consequence the climate of Seoul, the capital, is similar to that of New York, but without the extremes of heat and cold to which New York is subject. In general the arrangement of mountains causes Korea to turn her back to Japan and her face to China, a topographic fact that is reflected in the mental attitude of the Koreans toward her two great neighbors. The many outlying spurs of the mountains and the endless succession of hills and valleys caused one of the first foreigners who visited the country to remark that Korea looked like a gale-whipped sea that had solidified. In the extreme southeast two projections of the mountain system create the two harbors of Fusan and Masampo. Fusan is one of the two greatest commercial ports of Korea. Masampo has been reserved by the Japanese for a naval base and fortification. It is one of the best naturally protected harbors in the world, and is said to be as much superior to Port Arthur as Port Arthur surpasses Gibraltar.

From what has been said regarding the mountain slopes and relative number of rivers it is easy to judge that the eastern coast differs widely from the western. The eastern coast is little broken, has few harbors, and along it are no islands. The water off the shore is deep and the tides small, rarely rising more than two feet. In direct contrast, the western coast is bordered by nearly two hundred islands, and the shore is low, shelving, and abounding in mud banks, formed by the silt gouged from the mountains and carried to the coast by the rapid streams. An interesting theory, well supported by legends and geology, explains the shallowness of the western sea between Korea and the Shantung Peninsula in China on the ground that Korea and China were once united and that the Gulf of Pechili and the Yellow Sea were combined in one huge inland lake. The tides on this coast of Korea reach a height of 20-36 feet. The Chinese take advantage of the difference in tides by running their junks at high water close to shore, propping them up with stakes. When the tide is low, the freight is unloaded on foot, then the junk is reloaded and at high tide is floated away. Sea-going vessels must anchor three miles off shore and transfer their cargoes to lighters. Navigation on the west coast is dangerous, due to the mud banks, the counter currents between the

islands and, at certain seasons, dense fogs from off the Yellow Sea. Yet this is the coast that has the largest shipping and greatest number of harbors in use. Such a condition is brought about because the coastal plain of eastern Korea is too narrow to support a large population and the eastern mountain slope is too steep for agriculture, unless grain could be planted with a rifle, as it is said to be in West Virginia. Therefore in Korea the people live on the more gentle western slope of the country and along the wider western coastal plains. Hence the western sea is necessarily used rather than the eastern, for the high mountain backbone prevents the use of the few excellent eastern harbors with the carriage of goods overland to the people on the west. Furthermore, the Koreans have, until recently, been more closely tied to China on the west by political and social bonds than to Japan on the east.

With mountains covering so large a proportion of the surface, and with a generous rainfall, one would expect Korea to be a well-forested country. At least 73 per cent. of the area ought to be tree-covered, yet Korea is poor in timber, because the trees are given no opportunity to grow. Fuel is scarce and high priced, so the wood is always kept cut to the limit. Weeds, grass, animal and human excrement and kitchen refuse are made to supply the lack of better fuel. There are forests on the Yalu, the northwestern boundary, and on the eastern slope of the mountain ranges, where Japanese woods and our familiar oak, chestnut, willow and pine all grow in varying numbers, but these woods are not now easily accessible or available for most of the population. Lumbering is exceedingly crude, consisting almost entirely of whip-sawing. There is one saw mill at Seoul and another at the Yalu River, but these are small and do not begin to meet local needs. There is a heavy demand for lumber all over Korea. The price for lumber now is almost prohibitive and places it among the luxuries. For building houses the lack of boards is met by the supply of bamboo. The framework is bamboo, which is covered with a plaster of mud. The roof is straw-thatched, so that at a distance even a large city has the appearance of a vast barnyard filled with a grand array of haycocks.

History

The political history of Korea is of commanding interest because of its sublety, Oriental indirection, plots and intrigues. It is necessary to know a few of the important events of the past in order to understand and interpret present conditions or to pre-

dict the future. Although Korea existed as a nation 2,000 years before America was discovered and has a recorded history from 1200 B. C., the first event of modern interest was the invasion of the country by the Japanese Empress Jingo in 1 A. D., which gave Japan her first claim on Korea and awakened a desire in Japan for the possession of Korea's rich rice lands so near at hand. The second invasion occurred in 1592 when the Japanese under Taiko Hideyoshi, actuated only by the love of conquest, overran the peninsula. Korea called upon China for aid, and for eight years China and Japan ravaged the territory, each nation as great a scourge as the other to the helpless country that lay between them. At the end of the war, Korea was well-nigh exterminated. From the ravages of this double invasion she has never recovered. Since then her nobility has been corrupted by intriguing with the two neighbors. The best blood of the land was annihilated and the most skilful artisans carried into captivity. From that time until recently Korea paid tribute to both China and Japan, although China was recognized as Korea's overlord. The war caused Korea to hate all foreigners most bitterly, and she adopted a policy of exclusion, which was not shaken until 1882, when an American treaty opened her ports to foreign commerce. The invasion brought Chinese and Korean arts, culture and civilization to Japan, and supplied the first impetus to her growth among nations. Affairs in Korea remained quiescent until 1868, when Japan began taking steps to gain a more decisive interest. After years of intrigue, China and Japan came to blows in 1894-5 to decide which should be supreme in the peninsula. As a result of the war Korea changed overlords, for China was driven out. But a new figure was added to the contest for the rulership, by the activities of Russia. Japan was denied the fruits of her victory over China, and Korea lent a willing ear to the advice of Russia. The Japanese-Russian war was fought in 1903-4 to decide whose interests were paramount in Korea. At the end of the war, Japan established there a Resident General, who was to advise the Korean Emperor in all his affairs. Since the Emperor was not forced to do more than listen to this advice, Japan formally annexed Korea in 1910, made it a Japanese province, changed its name to Chosen, and began a long series of reforms.

Japan's interest in Korea is easily explained. Japan is situated on mountainous islands with limited resources. She was an agricultural nation, long self-supporting, but of late years her pupulation has increased at the rate of 600,000 to 700,000 a year. Agri-

culture has been pushed to the limit of intensity, but is unable to support the population. Japan has been forced to become an industrial and commercial nation, but she can neither feed herself nor supply the raw materials for her own factories. She cannot add much to her resources by intensity of culture, so must look to new lands. The most available are Korea and Manchuria. Neither of these places is populated anywhere near so densely as Japan and both have the very resources Japan needs, so Japan's attitude toward the two places is perfectly logical and necessary. For the protection of her markets, as a means of sustenance and also to preserve her very integrity as a nation, Japan must control them, for Korea in the hands of a power hostile to Japan would be a veritable dagger pointed at Japan's heart. The chief obstacle Japan has to meet in the development of her new province is the deep-rooted hatred of Koreans for all things Japanese, but this she hopes to overcome. What are the resources and possibilities of the country Japan has been so anxious to possess?

Industries

Agriculture. Korea is predominantly an agricultural country. Agriculture is the one great resource, and fully 75 per cent. of the whole population are engaged in farming. Even the few artisans that Korea possesses come from the farming group, and most of the artisans are farmers also. Although the country has rich forests in the north, and notwithstanding the fact that minerals add to her natural wealth, and that the waters off her shores abound in fish, agriculture overshadows all other forms of industry, and is more important than all the others added together. This statement may sound strange when one reflects that the greater part of Korea's area is occupied by mountains. It is true that the territory is lacking in plains, but the jumbled mass of hilly country creates many fertile valleys. The soil in these little pockets is enriched by the silt washed into them continuously by the streams, for each individual valley has its own particular mountain torrent supplying it with both soil and moisture. In addition, the valley alluvium is mixed with disintegrated lava, for Korea was once the seat of active volcanoes.[4] The combination of silt and volcanic ash creates a soil that can hardly be surpassed for fertility. It is an exactly similar soil that has made India so richly endowed in farming, and has enabled her to support such

[4] Paik Tu San is an extinct volcano.

a teeming population. It must be admitted, however, that the Korean mountains do most effectively limit agriculture, for only ten per cent. of the whole land mass can possibly be tilled. Not even that small amount is actually under the plow. It is estimated that the cultivated area is equal to 6,750,000 acres,[5] and that there are 2,000,000 acres in addition that are fit for farming but are as yet untouched. Even the lands that are worked are not made to produce to their fullest capacity. For example, the Korean rice crop is only 25 bushels[6] to the acre, whereas Japan raises 34[7] and the United States 35[8]. The reason for this is not due to the indolence[9] of the Korean peasant but to the practices of the former Korean government. Under the old system a man had no incentive to grow more than he actually needed for his own family, for any surplus crop would not enrich him but would be stolen by corrupt officials under the guise of taxes. So agricultural methods were not improved, nor the lands brought to their fullest use. The Japanese government has sought to change the attitude of the farmer toward his land by lessening the severity of the government upon the farmer. The state now seeks to better farming by establishing experiment stations, model farms and by distributing seeds and agricultural implements, and by encouraging the use of waste lands. In the short time this changed policy has been in vogue crops have been made greater in volume and the cultivated area increased by a million acres.

Rice. The relation that agriculture bears to all other industries is reflected in the preponderance of rice over other crops. The rice-growing zone of the world lies between the Tropic of Cancer and 40° N. All but the extreme northeastern tip of Korea lies within this area. Rice is a crop that requires a heavy summer rain. The warm southwest winds that rise in the Indian Ocean in the summer and sweep across the Pacific and the Yellow Sea bring to Korea, which stands directly across their path, a copious supply of moisture. All of Korea falls under the influence of these rain-bearing winds, but the southwest gets the greatest benefit from them. In the winter, the winds blow from the northeast, from the interior of Siberia, and have little moisture in them. Korea gets her rain when she needs it most, in the summer. The

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[5] British Consular Report.
Japanese Report on Reforms and Progress in Korea 1911–12.
[6] Report on Progress in Chosen.
[7] Japan Year Book 1910.
[8] U. S. Census 1910, Vol. V, on Agriculture, p. 621.
[9] Korean peasants who emigrated to Manchuria became successful farmers.

average rainfall of Korea is 36 inches, of which 21 falls in the warm months of June, July and August. Rice is planted in nurseries in May, transplanted to paddy fields in June, and harvested in October, so the distribution of rain, as far as rice is concerned, could not be bettered. The best rice grows on low, muddy plains. Very fortunately the little lowland that Korea possesses is, for the most part, in the southwest, just where the greatest rainfall comes. Although the general average rainfall is 36 inches the southwest is blessed with 42 inches, so the two factors necessary for the best rice production, heavy summer rain and low land, are found in southwest Korea.

There are two distinct varieties of rice, that grown on lowlands under water and known as "paddy," and that grown on higher, drier land and known as "upland." Paddy crops yield more per

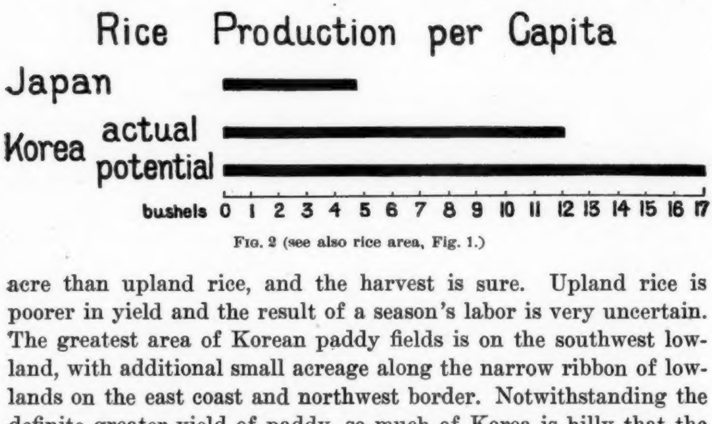

FIG. 2 (see also rice area, Fig. 1.)

acre than upland rice, and the harvest is sure. Upland rice is poorer in yield and the result of a season's labor is very uncertain. The greatest area of Korean paddy fields is on the southwest lowland, with additional small acreage along the narrow ribbon of lowlands on the east coast and northwest border. Notwithstanding the definite greater yield of paddy, so much of Korea is hilly that the number of acres in upland rice is almost double that in paddy fields, so upland rice is the characteristic crop of Korea. The country is so well fitted for rice production that it is grown over the whole arable area, and, in fact, 6,345,181 acres of the total 6,750,000 acres are devoted to this one crop. Because of the large yield on the one hand, and the unremitting labor required, which makes cheap labor necessary, rice is particularly fitted to a dense population.

Japan, long accustomed to a rice diet, cannot supply enough for her own needs. Korea has more than sufficient to feed her own population, and so, under Japanese control, will not decrease the acreage under rice, but rather will increase it, and endeavor

to make the yield per acre larger. They hope also to stimulate rice growing by removing the export duty on it. So far Korean rice has been inferior to Japanese because of the crude methods of culture, but more largely on account of the careless way in which it was cleaned and shipped. It was mixed with sand, stones, seeds and weeds. The Japanese have given instruction in the proper preparation of the rice and have distributed improved rice combs among the Korean farmers. Rice is Korea's greatest export, and all of it goes to Japan. What the Mississippi Valley is to the United States, Korea is to Japan. In Japan much of the former land devoted to rice has become too valuable for that purpose. It is now being used for factory and town sites, so Japan is forced to turn to Korea or some other nation for her rice. Japanese rice is of such good quality, and therefore so high priced, that only the richer people can afford to eat it. The farmer sells his own rice crop in the town and then buys Korean or Indian rice for his family's food. At least a third of the rice eaten by the poor people in Japan comes from Korea. Japan's need and Korea's supply of this one staple are enough to explain Japan's active interest in Korean affairs.

In Korea, the rice kernel is eaten by the people and distilled into rice beer. The outer husk is ground to a bran and makes excellent cattle food. The straw is used for fodder, for weaving mats, hats and baskets, for making paper, and for thatching roofs. So rice is far more than a mere staff of life in Korea. It is the one thing that makes life possible.

For the most part rice is grown on small holdings. The average size of a paddy field owned by one farmer is one acre. The upland rice fields are slightly larger, the average size being one and three-fourths acres per family. This state of affairs is not likely to continue, especially in the southwest and southeast. Rice land sells for $15[10] an acre in Korea. Land of the same character is valued at $150 per acre in Japan. Hence Japanese capitalists have sought to acquire large holdings of Korean lands, because the reforms instituted in Korea since its annexation are sure to enhance the value of rice property there and bring it near to a parity with Japanese land values. The simple-minded Korean peasant, dazzled by the sight of ready money, is easily induced to part with his holdings. Therefore the future may see the great rice areas of Korea worked under the tenant system. Already the Japanese holdings in southern Korea are 180 acres per Japanese farmer,

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[10] British Consular Reports.

which is 50 times the average holding in Japan. There are 37,500 acres owned by Japanese in southern Korea alone, and six times that amount in the whole peninsula. Herein lies part of the explantation of the hatred of Japanese by Koreans.[11]

Wheat. Although rice occupies the foremost place in Korean agriculture, it must not be understood that Korea has no other cereal crop. Nearly all the temperate zone grains are grown, but their production is distinctly secondary and supplementary to rice. Next to rice, wheat is the most important farm product. In direct contrast to rice, wheat is a dry climate plant. Yet wheat is grown in exactly the same places in Korea where rice is found. This seeming paradox is explained by the fact that Korean rainfall is a summer phenomenon. Therefore Korean winters are dry. It is in this season that wheat is planted on the southern rice areas. It is harvested just before or just after the rainy season commences. In seasons of great drought or delayed monsoons wheat takes the place of rice.

As one progresses northward in Korea the amount of rainfall gradually decreases and the climate becomes cooler. Following along the line of decreased rainfall one finds an increase in the wheat acreage, so that wheat is more typical of northern Korea than of southern. The extreme northwest of Korea has the least rainfall because it is furthest removed from the influence of the moist southwest winds and because it is surrounded by land masses and not water. Hence it is in this region that we find wheat most predominantly. The wheat crop per year in bushels is just about half as great as the rice, but since rice has a higher farm value per bushel[12] than wheat even this difference in bushels does not represent the real distinction between the two.

Other Cereals. What is true of wheat is also true of millet, barley and maize. They are planted and harvested before the rice crop is ready and before the rainy season sets in, or else are emergency crops in periods of prolonged dryness. Millet is only one-third as important a crop as rice, and barley and maize rank much lower than millet. Soya beans supplying in the Korean diet the nitrogen that rice lacks, have always been important as a supplementary supply crop, and are just beginning to appear as an export, especially into Asiatic Russia and Japan. Besides supply-

11 It is only fair to say that much of the land was formerly worked under the tenant system, members of the Korean nobility being the landlords.

12 In the U. S. wheat yields 15 bushels per acre at 96 cents per bushel, or value per acre, $14.40. In the U. S. rice yields 35 bushels per acre at 73 cents per bushel, or value per acre, $25 55. (Census 1910, Vol. V.)

ing the people with food, the bean yields an oil, its outer husk becomes a fertilizer and cattle are fed on the kernel. Tobacco is another crop found on every farmer's land and used by his own family. The tobacco is of good quality, but often spoiled in curing, so that it has a vile smell when smoked. All the people of both sexes smoke. The favorite pipe is a long-stemmed affair with a brass bowl, and is often highly ornamented.

Among the agricultural enterprises that Japan is encouraging in Korea one of the most significant is the attempt to raise cotton. Korea has never been without cotton as a crop, in the same regions where paddy fields prevail,[13] but the cotton has been poor in quality and low in quantity. To raise both the quality and quantity Japan sent men to the United States to study our upland variety. These men have attempted to introduce American methods and American

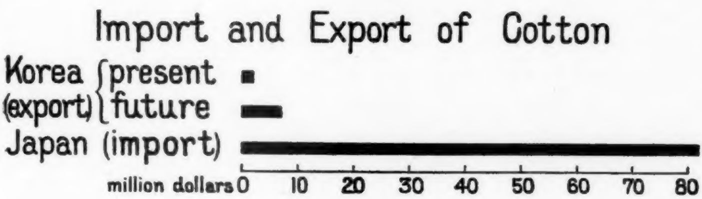

Fig. 3.

cotton seed into Korea, but have met with no great degree of success. The experts themselves did not have time to learn very much about our system and our plant. When they attempted to introduce the plant in Korea they were dealing with a people not born and bred to cotton raising and picking as are our negroes, and furthermore the Japanese overseers and Korean laborers did not speak the same language. The combination of new type of plant, new methods of work and directions given in a new tongue have militated against the experiment. All of these will disappear in time, and since Japan has a strong interest in having Korea's cotton, to help supply her spinning and weaving factories, we may rely on cotton being more extensively grown in Korea in the future. The area under trial cultivation increased from 108 acres to 6,439 acres[14] between 1906 and 1911. In all Korea 70,000[15] bales are produced per year from about 300,000 acres, an area which might

[13] Cotton requires the same climate that paddy rice demands.

[14] Japanese Report on Reforms and Progress in Korea, 1911-12.

[15] U. S. Dept. Agriculture.

be almost doubled.[16] If we accept the Japanese estimate that 500,000[17] acres in Korea may be put into cotton, and that the yield should be 266,000 bales, we can readily find out just how valuable a source of cotton supply Korea may become to Japan. It is estimated that the Korean uses 2⅔ lbs.[17] of cotton per year. If we subtract the 69,160 bales needed by Korea's 13,000,000 inhabitants, we have left 196,840 bales for Japan's use. At $37.50 a bale this cotton would be worth $7,381,500. Japan now imports cotton valued at $86,737,300, so the maximum amount that Korea could produce would not greatly affect Japan's cotton factories.

A second industry allied to agriculture that is being introduced is sericulture. But before this can become a success the Koreans must be sufficiently trained in the habit of work to look for a by-time job such as silk culture affords, and also the Korean squalid, dirty hut in which the silk worms are grown must be made higher, cleaner, and far more light and airy, for silk worms above all else require sunlight and ventilation. In northern Korea the cultivation of wild silk is a possibility.

Ginseng. Ginseng, a peculiar man-shaped root, whose only real value is the faith the Chinese place in it, has long been an important source of income to Korea, where it grows most abundantly. It was in ginseng shipped to China that Korea paid her tribute to that country for so many decades. There are two varieties of ginseng, the wild and the cultivated. The wild grows in the northern mountains and is so valuable that the finding of one root in three years gives enough return to supply the livelihood for that period to the family of the finder. Roots of this character sell for $150 a pound. Cultivated ginseng requires constant care for seven years before it is ready to be prepared for market. Its natural color is white, but the Koreans treat it by a steaming process so that it is of a pinkish hue when seen in the Chinese market. The cultivated variety is valued at about $2 a pound, but roots that most closely resemble the human figure have a much enhanced price. The importance of the crop is not measured by the amount of land devoted to it, but by the money derived from it, and further, the fact that it formed an export material in a country that is poverty-stricken in that respect. Although barely 275 acres are planted in ginseng, yet the annual value of the crop is $130,000.[18] The Chinese use ginseng for a universal panacea, and also to quicken

16 Maximum acreage 500,000 acres. (Japan Year Book 1910.)

17 Japan Year Book 1910.

18 This is the present acreage and value. Both were formerly much greater. Disturbed conditions in the country explain the falling off in export.

the amorous desires of a man, but it has no real qualities that fit it for either purpose. The ginseng market and the center of its culture are at a town northwest of the capital city.[19] Until the opening of the Japanese-Chinese war ginseng was a government monopoly. Between 1894 and 1908 the monopoly was farmed out to private individuals with the result that the crop suffered seriously from diseases that attacked the roots. The Japanese have again brought it under state control.

Fruit. With the farm land so cut up by hills, and with a good rainfall, one would expect to find fruit growing important in Korea, but this is not the case. The dearth of timber and the need for fuel explain why fruit trees are not often seen, although the country seems well fitted to supply most of the temperate zone fruits. In the south, a fruit tree would be cut for firewood long before it reached the bearing stage. In the north, greater severity of climate, distance from market and lack of labor, prevent orcharding. With Japanese control in Korea, fruit trees might be better protected, but it is not very probable that orchards will soon become a familiar sight, because, in Japan itself, the raising of fruit is a new industry, and the taste and desire for fruit have not yet become general.

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19 The province in which the capital is located and the one just northwest are the chief ginseng regions.

(*To be concluded*)

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Exhibition of Maps to Illustrate the Scene of Military Operations. A number of maps illustrating the seat of military operations carried on at present throughout the world are on exhibition in the Society's building. Philip's Army and Navy League map of the world is used to show the site of campaigns undertaken on the different continents. The scene of the European campaigns is shown on Stanford's Map of Europe as well as on several detail sheets which comprise: (1) portions of the 1:100,000 topographic map of Belgium by the Institut Cartographique Militaire; (2) sections of the 1:200,000 map of France published by the Ministère des Travaux Publics in Paris; (3) Vogel's 1:500,000 Karte des Deutschen Reiches; (4) sheets of the 1:300,000 map of Central Europe published by the k. u. k. Militärgeographisches Westliches Russland.

The field operations of the western European campaign are resumed on Colonel Frater's 1:864,000 "Carte de la Frontière Nord-Est de la France," while the Russian invasion of Germany and Austrian is shown on Fleming's Westliche Russland.

Plans of fortified cities and their environs are also exhibited to illustrate sieges and investments. The region around Paris is shown on 9 sheets of the 1:50,000 topographic map of France issued by the Service Géographique Militaire. Barrère's "Environs de Paris dans un rayon de 30 kilomètres" is also used.

In addition to the above, certain maps showing features of strategic value have been added to the exhibits. They include aviation maps consisting of sheets of the "Carte de l'Aéro-Club de France" on a scale of 1:200,000 on which only the detail visible at height is represented; Philip's Wireless Map of the World showing the location of wireless stations and Bartholomew's British Naval Chart showing coaling stations.

The theater of naval operations directed against coast cities is illustrated by charts compiled in European hydrographic offices.

The scene of the action of the Franco-English fleet at Cattaro is exhibited on an Austrian chart on a scale of 1:80,000. The remarkable double-bay feature of this harbor is excellently represented on this chart.

It is proposed to exhibit maps of other localities should the war unfortunately progress into new districts. The collection is a comprehensive map view of the war. It is open to the public and is being attended by over 5,000 visitors monthly.

NORTH AMERICA

Meeting of the International Congress of Americanists Postponed. Mr. W. H. Holmes, Chairman of the organizing committee of the XIXth International Congress of Americanists, announces that the members of the Congress have voted almost unanimously in favor of the postponement of the Washington session. Most of them think it would be unfair to the European members and delegates to hold the meeting at a time when they cannot attend. The committee therefore decided that, in view of the present condition of European affairs, the Congress should be postponed to a date to be determined later. The programme will remain unchanged save in so far as the organizing committee may be able to enrich and perfect it. It is hoped to hold the session next year.

The American Association to Meet in San Francisco. The American Association for the Advancement of Science will hold its general meeting in San Francisco and the neighboring university towns in 1915. The sessions will begin on Monday, August 2, and terminate on Saturday August 7. The general sessions and the general evening lectures will be in San Francisco,

and sessions for the presentation of addresses and papers in the separate divisions of science will be held chiefly at the University of California, Berkeley, and on one day at Stanford University. The Pacific Coast Committee will later supply information as to transportation, living accommodations, excursions, etc. The Pacific Coast Programme Committee suggests that the topics should relate, as far as possible, to problems of world interest which pertain especially to the Pacific area. There will be four general sessions for the delivery of addresses by eminent men on subjects of wide interest. Certain half or whole days of the week will be left free from scientific programmes in order that members may visit the exposition and other points of special interest. The scientific societies of the country are invited to hold their 1915 general meetings in San Francisco, at the same time, in affiliation with the American Association, and to appoint representatives to cooperate upon general features of the programmes, in arranging joint programmes, etc. Professor Ulysses S. Grant, of the Northwestern University, Evanston, Ill., is President of Section E (Geology and Geography) of the Association, and Professor George F. Kay, of the State University of Iowa, is Secretary.

ASIA

Sir Aurel Stein's New Expedition. The *Geographical Journal* (July, 1914, p. 40) gives some information about the work of Sir Aurel Stein since October, 1913. He started in that month from Kashgar for the Lop-nor region via Khotan. In the neighborhood of Maralbashi, at the foot of the most southern range of the Tian Shan, he surveyed a number of ruined sites going back to pre-Mohemmedan times. This region was wholly devoid of water, and, in attempting to cross the desert to the lower Khotan River, traveling was so difficult that it became necessary to turn northwards in order to save the camels. A small area of eroded ground was discovered bearing abundant remains of the Stone Age thirty miles from the Tarim River. The Tarim was then crossed and the party hurried on to Niya where the sand-buried settlement in the desert, abandoned in the third century, A. D., was revisited and some new discoveries made, especially writings on wood in the Indian language and script.

An Indian surveyor, who had been sent on ahead, carried on triangulation along the main Kuen Lun range for over 5° of longitude when heavy snowfall stopped his work. The result is that a net, connecting with the Indian trigonometrical survey, has now been carried beyond the actual Lop-nor.

Sir Aurel Stein, at the end of January, moved out into the desert north of the lagoons that terminate the Tarim River, where he found two ruined forts and a large settlement, all of the period closing about the beginning of the fourth century A. D. Many ruins were examined and fresh discoveries made showing especially the importance of the Chinese silk trade in the early part of our era. From this region the explorer went eastward on the famous ancient trade route through the desert, a journey leading to many interesting discoveries. The different parties united at Kum-kuduk and, at the date of writing, the explorer was preparing to move into Kansu for his spring work.

Protecting Chinese Monuments. Fifty-two American institutions of art and learning, in cooperation with the Asiatic Institute, New York, and the China Monuments Society, Peking, addressed a memorial, in June last, to the President of China urging means for the protection of Chinese monuments and antiquities from vandals. Essentially the same body memorialized Secretary of State Bryan, urging the employment of United States officials in the suppression of vandalism in China and the protection of American citizens and institutions from association with the criminal traffic in broken and plundered Chinese antiquities. Secretary Bryan replied that he was in hearty sympathy with the movement and that the Department of State had sent the memorial to the American Minister at Peking for distribution to the Consuls of the United States to China with instructions to use all proper endeavors to further the suppression of vandalism in China on the part of American citizens.

Exploration of the Upper Brahmaputra. In a paper read before the Royal Geographical Society on June 22, Captain F. M. Bailey described his exploration of the Sangpo, or Upper Brahmaputra River. The main results of the expedition were as follows:—The mapping of some 380 miles of the Sangpo, which had previously been done by untrained or untrustworthy explorers; the mapping of the lower course of the Nagong Chu; the discovery of Gyala Peri, a snow-peak 24,460 feet in height and its glaciers. By observing the river where it breaks through the Himalayas some information regarding its enormous drop has been gained, and the falls reported to be 150 feet in height have been proved to be merely an exaggerated rapid of thirty feet. The upper waters of the Subansivi have been discovered, and it is proved that this river rises north of the Himalayas, and breaks through the range. Many new snow-peaks, ranges, and rivers have been discovered, and a small collection of mammals, birds, and butterflies, among each of which were new species, was made.

EUROPE

A Lecture Hall for the Royal Geographical Society. The President of the Society, the Right Hon. Earl Curzon of Kedleston, at the anniversary meeting on May 18, said that arrangements had been practically concluded for the erection of a lecture hall on the grounds of the Society to seat 1,200 persons with additional rooms that will be available for smaller audiences or for exhibitions on an extended scale.

POLAR

Antarctic

The Shackleton Expedition off for the Antarctic. The *Endurance*, one of Sir Ernest Shackleton's two vessels in his new Antarctic enterprise, sailed from Plymouth, England, on August 8, for Buenos Aires with a crew of seventeen and six members of the expedition. Shackleton and the remaining members of his Weddell Sea party left England on September 18 for Buenos Aires, where they will meet the *Endurance* and sail for their destination. They propose to establish a winter camp on the coast of Prince Luitpold Land, the part of the Antarctic Continent discovered by Filchner in 1912. The *Endurance* will leave Buenos Aires about October 15, proceed to the Falkland Islands and thence to South Georgia, where she will finally coal before entering the Weddell Sea. She will leave South Georgia about the second or third week in November and a landing, it is hoped, will be effected early in December.

The personnel of the shore party (*Geogr. Journ.*, August, 1914, pp. 216-217) consists of: Sir Ernest Shackleton, leader; Frank Wild, second in command, in charge of provisions; George Marston, in charge of clothing and general equipment; Tom Crean, in charge of sledges; Captain O. Leese, in charge of motors; Lieut. F. Dobbs, and Lieut. C. Brocklehurst, each in charge of a section of dogs; J. McIlroy, surgeon and zoologist; R. W. James, of Cambridge, chief physicist and magnetician; L. Hussey, assistant physicist and magnetician; J. M. Wordie and V. Studd, geologists; F. Hurley, photographer and cinematographer; and a cook and dog-driver. Of this party of 15, Shackleton, Wild, Marston, Crean and Hurley have had previous Antarctic experience.

Shackleton plans to cross the South Polar continent from Weddell Sea to Ross Sea. He will strike out for the South Pole and from there to Beardmore Glacier, Ross Sea. This glacier was a part of the route both of Shackleton and Scott on their South Pole journeys from and to McMurdo Sound.

The destination of the second part of the expedition is Ross Sea. The ship *Aurora* will leave an Australian port about Dec. 1 and will land at McMurdo Sound (where both Scott and Shackleton had their headquarters in their Antarctic work) the following party: Lieut. Æneas Mackintosh, leader; H. Wild, in charge of stores; E. Joyce, in charge of dogs and sledges; A. Ninnis, in charge of motors; and a geologist.

This party will proceed at once to the south, lay a depot at the foot of

Beardmore Glacier and remain on the lookout for the transcontinental party. If they do not cross over the first season the depot party will return to McMurdo Sound and winter there, leaving the Antarctic the next season. Mackintosh and Joyce have had previous experience in the Antarctic.

The *Endurance* was recently built in Norway under the name *Polaris* with a view to cruises in the polar seas. Her length over all is 144 feet; breadth, 25 feet; mean draft when loaded, 13 feet. When steaming 7½ knots an hour the coal consumption per day is about three tons. The *Aurora* was Sir Douglas Mawson's ship in his recent expedition to the Wilkes Land coast.

Arctic

Stefansson's Northern Journey. In Vilhjalmur Stefansson's letter to the Society dated Point Barrow, Alaska, October 31, 1913 (*Bull.*, Vol. 46, 1914, March, pp. 184-191)), he said:

"The two chief features of my winter plans are a sledge journey north from Barter Island and the exploration of the Mackenzie delta. Both these projects may prove to be of considerable geographical interest. The ice journey over the sea north from Barter Island should be made in February and March. If we should attain a point only 100 miles from shore we might determine the edge of the continental shelf at least; while if we should find ice conditions favorable 300 miles does not seem too much to hope for . . . As far as I know no vessel has ever been over fifty miles from shore in the longitude of Barter Island. Barter Island hugs the coast in about 144° W. L."

A despatch to the *New York Times* from Toronto, September 1, signed by Burt M. McConnell, meteorologist of the Stefansson expedition, says that Stefansson started on his contemplated ice trip from Martin Point (about 143° W.), Alaska, on March 22,* with four sleds, twenty-five dogs, and six men. A supporting party, with two sleds and thirteen dogs was to accompany Stefansson ten days due north carrying provisions and dog food. The supporting party was then to return to shore taking barely enough provisions to last.

On March 25 the party was stopped by open water. Stefansson and McConnell shot seal which served for food for both men and dogs. On March 27, Stefansson sent some members of the supporting party back to Martin Point. The party then traveled due north until April 16, when it arrived at the edge of the continental shelf,† where there was plenty of open water. Here Crawford, Johansen, and McConnell were sent ashore, and Stefansson, Ole Anderson and Storkensen, with a good sled, six good dogs, two rifles and plenty of ammunition, continued north. Stefansson said that he would turn back at the end of fifteen days. On account of the lateness of the season unavoidable delays had prevented an earlier start. The party should have been under way in February.

Stefansson believed that the wind and currents might force him to strike eastward for Banks Island, where his party would live on the country till a relief vessel could be sent. Captain Lane of the *Bear* later cruised along the south and southwest shores of Banks Island within a half mile of the shore, and Captain Ottle of the *Belvedere* was also in that neighborhood whaling, but neither saw the beacons which Stefansson promised to build when he reached shore. McConnell says the inference is that Stefansson was unable to attain Banks Island. His party, McConnell adds, might survive for a year, as long as their ammunition held out. Stefansson is a man of unusual resource and, although the circumstances told by McConnell are unfortunate, there is no reason as yet to believe that the worst has befallen the explorers.

A despatch from Ottawa, on September 9, says that the schooner *Mary Sachs*, one of Stefansson's vessels, was reported to have left Herschel Island

* It thus appears that Stefansson was not able to start as early as he had planned.

† McConnell, if correctly reported, says that the continental shelf was reached in lat. 70°20' N., long. 140°30' W. If this is correct, the edge of the continental shelf was established not over thirty miles north of the Alaskan coast. About 100 miles further west, Leffingwell and Mikkelsen found the edge of the shelf about sixty miles north of the coast.

on Aug. 11 for Banks Island to establish depots for Stefansson's use if he succeeded in crossing the ice to Banks Island this fall.

The second part of Stefansson's programme, the mapping of the Mackenzie delta and the soundings of its channel, has been carried on by McConnell and Chipman. The geologist O'Neill has been exploring the Herschel Island River.

Ten Survivors of the Karluk Party Rescued. The U. S. Revenue cutter *Bear* arrived at Nome on Sept. 14 with ten survivors of the part of Stefansson's Arctic Expedition that was on the *Karluk* when, on Sept. 23, 1913, she was carried away in the ice off the mouth of the Colville River, Alaska. It will be remembered that she drifted west for 110 days, was crushed in the ice on Jan. 11, 1914, and Captain Bartlett with ten white men and some Eskimos reached Wrangell Island on Feb. 23 with supplies. An account of her drift and destruction, the subsequent adventures of her party, and the journey of Capt. Bartlett to Siberia and Alaska, with seaman Perry and some of the Eskimos, bringing the news to civilization, has been printed in the *Bulletin* (Vol. 46, 1914, July, pp. 520-523).

The ten persons who have been rescued are: William T. McKinlay, physicist in charge of observations on terrestrial magnetism, a graduate of the University of Glasgow; John Monroe, chief engineer; Bert Williamson, second engineer; Robert Templeman, steward; Ernest Chase, assistant steward; Frederic W. Maurer, fireman; an Eskimo, his wife and two children.

Two of the scientific men of the party and a fireman died on Wrangell Island and were buried there. They were: George Stewart Malloch, of the Canadian Geological Survey, a specialist in stratigraphy, who died of scurvy; Bjorn Mamen, assistant photographer and geologist, of Christiania, Norway, who accidentally shot and killed himself; and George Bretty, fireman, who died of scurvy.

According to a despatch in the *New York Times* (Sept. 15, 1914), two parties of four men each were not heard from after they separated voluntarily from their companions. One of these parties included first officer A. Anderson, second officer Charles Barker and two sailors named Brady and King. On the retreat from the *Karluk* they got within three miles of Herald Island and remained there with two sledges loaded with supplies, at the edge of the open water, while Mamen and two Eskimos returned to the scene of the shipwreck for more provisions. When the next party returned to Herald Island, on the way to Wrangell Island, the men were not to be found and were not later seen. The other party, consisting of Dr. A. Forbes Mackay of Edinburgh, surgeon of the Shackleton Expedition, James Murray, oceanographer, of Glasgow, who had been associated with the oceanographical researches of Sir John Murray, Henri Beuchat, a specialist in American archæology, and seaman Morris had left the *Karluk*, pulling their own sled, against the wishes of Capt. Bartlett, and were not seen again. It is believed that these eight men are lost.

The ten survivors on Wrangell Island were rescued by the gasoline schooner *King and Wing* and later were transshipped to the *Bear*, which was on her way to the island, her second attempt to reach it, as her first effort was defeated by incessant fog and ice. The *King and Wing* was a good boat, but it would have been impossible for her to force a way through the ice which in places rose high above the deck; there was much open water, however, and where the schooner could not force a way through the pack an opening in the ice was invariably found. There was open water along the coast to within two miles of the shore. A number of attempts have been made by vessels to reach Wrangell Island, but the *King and Wing* is the first to arrive very near it. Passage over the floe ice, to and from the two camps in which the survivors were lodged, was not difficult.

The *Bear* succeeded in getting within ten miles of Herald Island, but was unable to discover any evidences that the missing eight men had reached it.

Dr. Bruce's Expedition to Spitzbergen. Dr. W. S. Bruce left Edinburgh, on Thursday, July 9, on an expedition to Spitzbergen. The object of the expedition was hydrographic and geological research in Wybe Jansz Water, or Stor Fiord, where the coast is little known, and where there are

practically no soundings. Geological investigations formed an important item in the programme. Dr. Bruce was to be assisted by Mr. J. V. Burn Murdoch, who has previously twice accompanied him to Spitzbergen, by Mr. R. M. Craig, of the geological department of the University of St. Andrews, and by Mr. J. H. Koeppern, zoologist. Dr. Bruce was to be responsible for the conduct of the hydrographic work. The expedition was expected to be absent for about two months. It was supplied with instruments by the Admiralty and the Scottish Oceanographical Laboratory and was also supported by the Royal Geographical Society and the Prince of Monaco.

PERSONAL

Mr. Douglas W. Freshfield, the well-known alpinist and geographer, has been elected President of the Royal Geographical Society. Mr. Freshfield has written many books and articles chiefly concerned with mountains but also bringing geographical data into relation with history. It was due in part to him that the Royal Geographical Society's collection of photographs was made and that geographical education has taken its place among the recognized studies of the British universities. Mr. Freshfield recently visited our Society house on the occasion of a journey around the world.

The Academy of Sciences of Paris in July, awarded part of the Binoux Prize to Alfred Vialay for his book, "Contribution à l'étude des relations existant entre les circulations atmosphériques, l'électricité atmosphérique et le magnétisme terrestre." The book was noted in the *Bulletin* (June, 1914, pp. 456-457).

OBITUARY

Frederick Stanley Arnot. Mr. Arnot, the well-known missionary-traveler, died at Johannesburg in May. He had devoted his life to work for the welfare of the natives of south-central Africa. He went to Africa in 1881 and, in a few years, became known as an explorer as well as a missionary. He sought an elevated and healthful country in tropical Africa in which to establish a mission station and depended upon his own slender resources for the journey into the far interior. He won the confidence of unknown tribes by helpful ministrations to their sick; and, with the food they gave him and the game he killed, he and his few black attendants were able to penetrate many hundreds of miles into the interior, and finally he made his way to Bihe and Benguela, thus completing a diagonal journey across the whole of south-central Africa. His main purpose, however, was still unfulfilled and so he organized a new expedition by which he opened up a route that no one had traced. Traveling north of the sources of the Zambezi, he reached what is now known as the great copper region of Katanga, which he knew as Garenganze. Here he built his proposed missionary station and, after two years, returned to England to secure support for further work. He became well known to Africanists because, in his book "Garenganze or Seven Years in Central Africa," he gave to geographers a large amount of new information. In 1893 he published "Bihe and Garenganze" and, in 1902, brought out a connected account of his twenty years' work. He resembled his great example Livingstone in his gentle ways with the natives. He was always at peace with them and to this was largely due his success in mission work and in geographical reconnaissance.

Horace Carter Hovey. The Rev. Dr. Hovey has died at Newburyport, Mass., at the age of 81. He was a geologist who made a special study of cave formations and was the author of several volumes on the Mammoth Cave of Kentucky.

GEOGRAPHICAL LITERATURE AND MAPS

(INCLUDING ACCESSIONS TO THE LIBRARY)

BOOK REVIEWS AND NOTICES

(The size of books is given in inches to the nearest half inch)

NORTH AMERICA

Representative Cities of the United States. A Geographical and Industrial Reader. By Caroline W. Hotchkiss. viii and 212 pp. Maps, ills., index. Houghton Mifflin Co., New York, 1913. 7½ x 5½.

This attractive little volume was written for use in the grammar school, supplementing the geography. It has excellent features, yet there are defects in the method of treatment and in the sequence of the subject matter. Though intended to be a geography of certain cities, it is evident that the geography point of view is not maintained throughout the text. The cities discussed are San Francisco, Portland, Seattle, Denver, New Orleans, Duluth, Minneapolis and St. Paul, Chicago, Pittsburgh, Gary, Savannah, Boston, and New York.

Denver is described as the City in the Wilderness. It would be more appropriate to refer to this city in connection with elevation, gateways, tourists, mining or irrigation, for it is not known as a city in the wilderness. The volume is well illustrated and contains seven pages of statistical data in the appendix. G. E. CONDRA.

The Geology of Long Island, New York. By Myron L. Fuller. *U. S. Geol. Surv., Prof. Paper 82.* 249 pages, pls., maps, Washington, 1913.

The final appearance of the results of Mr. Fuller's work on Long Island in 1903-1905 will be a source of gratification to the many persons who are interested in this region. A large part of the report deals with the configuration of the island and the conditions under which it has developed, for the underground features are subordinate. It is a most interesting contribution to the physiography of the New York region and treated so thoroughly and clearly that it will be of great service. The area is one in which the formations of the Glacial Epoch and the immediately preceding and more recent times are particularly well displayed. From the many extensive and instructive exposures one can decipher the sequence of events of the Quaternary period. The conditions in earlier glacial time are especially clear, so the Long Island section is typical for a wide area. Fuller discusses the geologic history in detail and reviews its bearing on the Pleistocene of adjoining regions. Consideration is also given to the character and origin of the submarine channel of the Hudson River. In order to make the more salient features readily accessible to teachers and others there is given a long list of notable localities with brief statement of their character. The report includes a large topographic and a geologic map of the island on a scale of two miles to the inch and contour interval of twenty feet which will be very serviceable. There are also many special maps and other illustrations. N. H. DARTON.

The Story of California from the Earliest Day to the Present. By Henry K. Norton. 390 pp. Maps, ills., index. A. C. McClurg & Co., Chicago, 1913. $1.50. 7½ x 5.

Before Juan Rodriguez Cabrillo discovered California on Sept. 28, 1542, the inhabitants of the most favored portions of this land were only slightly advanced in the social scale above the brute. They had no common language, no tribes, no religion. At the present day, San Francisco is extending her eight miles of wharfage, and $25,000,000 are to be spent for this purpose in an effort to accommodate the increased traffic which is expected from Oriental commerce, and the opening of the Panama Canal.

Thus a great and striking change has taken place in this Pacific state from the time it was first seen by a white man up to the present day. It is with the social, political, and religious events that have occurred in this evolution of California that the book deals. Added to the historical value of the volume are its numerous illustrations and maps. WILBUR GREELEY BURROUGHS.

La República Mexicana. Reseñas Geográphicas y Estadistícas. Vera Cruz, 86 pp. Coahuila, 49 pp. $1.50. Nuevo Léon, 64 pp. $1.50. Chihuahua, 26 pp. $1.00. Chiapas. Por Enrique Santibáñez, 29 pp. $1.25. Sonora, 10 pp. 90 cts. Territorio de la Baja California. Por Léon Diguet. $1.50. Maps, ills., in each. C. Boret, Paris & Mexico, 1908-12. 13 x 10.

A popular description of Mexican territory by natives of the country. The work is informative in a broad sense with a tendency to emphasis on the country's natural resources and the economic conditions prevailing at the close of the Diaz régime. Condensed, yet clear descriptions of geographical and historical features as well as of the inhabitants and customs are presented along with numerous photographs and maps. It is to be hoped that the parts dealing with the remaining states will soon be issued. LEON DOMINIAN.

Life in Mexico during a Residence of Two Years in that Country. By Madame Calderon de la Barca. Everyman's Library. xxxviii and 542 pp. J. M. Dent, & Sons, London, 1913 (?). 1s. 7 x 4½.

The original edition of Mme. Calderon de la Barca's Life in Mexico appeared in 1843. The recent reprint in Everyman's Library is equally timely, for it is a book worth reading about the intimate side of conditions in a country of which we know so much and so little. The letters which make up the volume are personal narratives, written in a delightfully appealing style, full of keen observations, kindly humor and sane philosophy. Modern Mexico is so little changed, in many essentials, from the Mexico of three-quarters of a century ago, that these letters seem to be of the very present. The volume is for the odd hour, rather than for continued reading.

RICHARD ELWOOD DODGE.

Mexico, the Wonderland of the South. By W. E. Carson. xiii and 499 pp. Map, ills., index. The Macmillan Co., New York, 1914. $2.50. 8½ x 6.

A new edition containing data needed to bring the book up to date in view of the disturbances of the past three years. It is regrettable that the author did not arrange his topics in orderly sequence. He gives much accurate information that would be more useful if presented systematically. In spite of this defect the book is well worth reading. LEON DOMINIAN.

CENTRAL AMERICA AND WEST INDIES

Kostarika. Beiträge zur Orographie und Hydrographie. Von Prof. Henri F. Pittier. 48 pp. Map, profiles. *Ergänzugsheft No. 175 zu Petermanns Mitt.*, Gotha, 1912. 11 x 7½.

The map at the end of this monograph and the beautiful pen sketches that supplement it attract the attention far more than the text. The sketches give a clearer impression of the Costa Rican landscape than any quantity of photographs or than the forty-eight pages of description by the author. The ground plan of Costa Rica is here presented by a wealth of detail not formerly accessible in a single work. Each small subdivision of the country is described not only with reference to its mountain ranges, its valleys and plains, but also with reference to the individual mountains and even the hills and brooks. The result is that one may find here any topographic or hydrographic feature of Costa Rica in which he may be interested.

But, on the other hand, one finds little of philosophical interest. The trees and not the woods are kept constantly in the foreground. Such explanatory paragraphs as that on page 30, describing a recent change in the hydrography

of the Cordillera de Talamanca and the paragraphs on pages 31 and 32 dealing with the changes of level of the Atlantic coast seem rather more accidental than as parts of a definite plan. The long table of elevations, combined with the maps and detailed description, make this a valuable reference paper on the physical features of Costa Rica. ISAIAH BOWMAN.

The Panama Canal. A History and Description of the Enterprise. By J. Saxon Mills. 344 pp. Maps, ills. Sully & Kleinteich, New York, 1913. $1. 7½ x 5.

A third of the book is given to the canal project before the United States took hold of it. Excellent chapters are then given to the health problem on the isthmus and how it was solved and to the civil administration and phases of the social life after the arrival of the Americans. The problems of construction are then discussed, with chapters on the Culebra Cut and the locks. The completed canal is next described and the remainder of the book is devoted to a simply written exposition of the new ocean highways thus opened and the relations of the canal to the trade of the world. The author has succeeded in compacting a great deal of matter in small space and making all of it very readable.

The Panama Gateway. By J. B. Bishop. xiv and 459 pp. Map, ills., index. Charles Scribner's Sons, New York, 1913. $2.50. 9 x 6.

Although the output of books on Panama has been large during the past two years, few, if any, of their authors could claim to write with the fullness of knowledge which characterizes the present work from the pen of the Secretary of the Isthmian Canal Commission. Mr. Bishop first reviews the history of the events leading to the American purchase and control. He then gives an account of the construction and the conditions prevailing during the progress of the important work. His details, enlivened by bits of personal reminiscences, are illuminating. The work is probably the most instructive unofficial compilation on the canal. The author's position and his years of residence along the banks of the new waterway lend the weight of legitimate authority to everything he records. LEON DOMINIAN.

SOUTH AMERICA

South America. By W. H. Koebel. Series: The Making of the Nations. x and 292 pp. Maps, ills., index. A. & C. Black, London. The Macmillan Co., New York, 1913. $2. 8½ x 5½.

A creditable attempt to give the history of a continent within the narrow bounds of an ordinary volume. The presentation of events and conditions is brief perforce. It may not satisfy some readers. Nevertheless, the survey of South America's past is decidedly instructive. The mystery of the pre-Columbian period and the spell cast by the daring of explorers and colonizers burst through the limitations imposed by space. The author's genuine interest in South America is transcribed by a full-blooded hand. He writes broadly and impartially. The book should go far in imparting a better understanding of Latin Americans at this, the dawn of our intimacy with the many qualities characteristic of their race. LEON DOMINIAN.

The Amazing Argentine. A New Land of Enterprise. By John F. Fraser. 291 pp. Ills., index. Funk & Wagnalls Co., New York, 1914. $1.50. 8 x 5½.

A snappy, reportorial story of a tour through Argentina, which tells the tale of the now familiar South American tour, including the railroad trip in the tunnel through the Andes from Argentina to Chile. Although Argentina has far from reached its full development and is still a land of opportunity, there is a well-nigh insuperable chasm between the moneyed and the laboring classes. In spite of its stable government and sound financial system, Argentina still exacts a religious test of the occupant of the presidency. It supplies its grain and cattle to the world, it has an ever increasing railroad system, with luxurious modern accommodations, but it has no coal, and very little industrial development. There is no native art or literature. DAVID H. BUEL.

Ecuador. Its ancient and modern history, topography and natural resources, industries and social development. By C. R. Enock. 375 pp. Map, ills., index. C. Scribner's Sons, New York, 1914. 9 x 6.

The author has long been a careful student of the South American countries. The literary results of his labors have greatly improved in value since he began to write on these republics. The present volume is a well-ordered treatment of Ecuador in the varied aspects of country and peoples. It is packed with information, and the geography of the country has its full share of attention. The index, for its best usefulness, might well be more copious, and a map of larger scale would be more useful.

To the River Plate and Back. The narrative of a scientific mission to South America, with observations upon things seen and suggested. By W. J. Holland. xiii and 387 pp. Ills., index. G. P. Putnam's Sons, New York. 1913. $3.50.

A commonplace journey from New York to Buenos Aires was made a voyage of discovery through the observations and interests of a scientific observer. The object of the trip was to install in the National Museum of Argentina a replica of *Diplodocus carnegiei.* This book would be superfluous but for the keen insight of the writer, who looks upon the ocean as the "mother of life," finds spider webs in the air thirty miles from land, captures moths 400 miles out and views the heavens with a knowledge of their vastness and inspiration. A brief stop at Bahia and a longer one at Rio de Janeiro allows the naturalist to compare the life of the southern continent with the northern and, preferring the country to the town, he turns to the woodlands and also gives an unusual view of these southern ports of commerce. The days about La Plata are filled with trips to interesting points in Montevideo, La Plata, Mar del Plata and Tucumán, but it was the Museum at La Plata with its suggestions of past and present, the fossil beds of Mar del Plata and the cross-section of South American life in the side trip to Tucumán which attracted the author. Throughout the text there is a sprinkling of the present conditions, buildings, customs, industries and activities, to yield an appreciation of the present status of the country. The story has a delightful personal touch because of the wide acquaintance of Dr. Holland and, through the medium of his scientific mission, many new acquaintances, leaders in statesmanship and in science, are introduced. The author presents many photographs and eight of his own sketches in color. There are few books on the country about the river Plate which cover so much ground and yield so great a return to the reader as this one.

ROBERT M. BROWN.

The Putumayo. The Devil's Paradise. Travels in the Peruvian Amazon region and an account of the atrocities committed upon the Indians therein. By W. E. Hardenburg. Edited and with an introduction by C. R. Enock. Together with extracts from the report of Sir Roger Casement confirming the occurrences. 347 pp. Map, ills., index. T. Fisher Unwin, London, 1913 (?) 9 x 6.

This narrative is the record of the atrocities committed by the half-breed officials of the Peruvian Amazon Company upon the native rubber collectors of the Putumayo district, lying between the Cara-Parana, and Igara-Parana, tributaries of the Amazon in the Loreto district of Peru. W. E. Hardenburg, an American engineer, and his companion W. P. Perkins, penetrated the Putumayo district, barely escaped with their lives from the half-breed officials of the rubber company, and describe outrages on the natives, which rival, if they do not surpass, the atrocities of the Congo rubber district. These charges were taken up by the London *Truth* and the Anti-Slavery Society, and resulted in an investigation by the British Foreign Office which substantiated the allegations. The Peruvian Government at first denied the accusations and afterwards claimed the outrages had been stopped. But they are said to exist still.

DAVID H. BUEL.

OTHER BOOKS RECEIVED

These notes do not preclude more extended reference later

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NEW MAPS

EDITED BY THE ASSISTANT EDITOR

For system of listing maps see p. 74 of this volume

MAPS ISSUED BY UNITED STATES GOVERNMENT BUREAUS
U. S. GEOLOGICAL SURVEY

Topographic Sheets
(Including Combined and Special Topographic Maps)

Arizona. Phoenix Quadrangle. Surveyed in 1903-1904 and 1912. 1:62,500. 33°30′ - 33°15′ N.; 112°15′ - 112°0′ W. Contour interval 25 ft. Edition of June 1914.

California. Petaluma Quad. Surveyed in 1910-1912. 1:62,500. 38°15′ - 38°0′ N.; 122°45′ - 122°30′ W. Interval 25 ft. Edit. of June 1914.

California-Nevada. Mt. Morrison Quad. Surveyed in 1911-1912. 1:125,000. 38°0′ - 37°30′ N.; 119°0′ - 118°30′ W. Interval 100 ft. Edit. of June 1914.

Minnesota. Deerwood Quad. Surveyed in 1912. 1:62,500. 46°30′ - 46°15′ N.; 94°0′ - 93°45′ W. Interval 10 ft. Edit. of June 1914.

Ohio. Troy Quad. Surveyed in 1911-1912. 1:62,500. 40°15′ - 40°0′ N.; 84°15′ - 84°0′ W. Interval 10 ft. Edit. of June 1914.

Oklahoma. Nowata Quad. Surveyed in 1912-1913. 1:125,000. 37°0′ - 36°30′ N.; 96°0′ - 95°30′ W. Interval 50 ft. Edit. of July 1914.

Oregon. Oregon City Quad. Surveyed in 1911-1912. 1:62,500. 45°30′ - 45°15′ N.; 122°45′ - 122°30′ W. Interval 25 ft. Edit. of June 1914.
[Includes the southern part of the city of Portland, the nucleus of which is shown on the adjoining Portland sheet (latest edition, 1905).]

Washington. Malaga Quad. Surveyed in 1911-1912. 1:62,500. 47°30′ - 47°15′ N.; 120°15′ - 120°0′ W. Interval 25 ft. Edit. of July 1914.

Maps Accompanying Publications

Illinois. (a) Map Showing Areal Geology of the Peoria Quadrangle, Illinois. 1912. Geology by State Geological Survey. 1:62,500. 40°45′ - 40°30′ N.; 89°45′ - 89°30′ W. 14 colors.

(b) Map Showing Economic Geology of the Peoria Quadrangle, Illinois. 1912. Geology by State Geological Survey. Same scale and coordinates as map (a). 10 colors.

Accompany, as Pls. I and II, in pocket, "Geology and Mineral Resources of the Peoria Quadrangle, Illinois" by J. A. Udden, *U. S. G. S. Bull. 506*, 1912.

Kentucky. (a) Topographic Map of the Southeastern Part of the Monticello Quadrangle, Kentucky, Showing Location of Oil and Gas Pools, Deep Wells, and Outcrop of and Structure Contours on the Spann Limestone Member of the Pennington Shale. 1:62,500. 36°53.3′ - 36°45.0′ N.; 84°53.3′ - 84°45.0′ W. 4 colors.

(b) Sketch Map of Wayne County, Ky., Showing Location of Oil and Gas Pools. [1:230,000]. [37°0′ - 36°35′ N.; 85°3′ - 84°30′ W.]

(c) Sketch Map of a Portion of Little South Fork Oil District, Wayne County, Kentucky. [1:24,000]. [36⅝° N. and 84¾° W.] 1 color.

Accompany, as Pls. III, IV and VI respectively, "Reconnaissance of Oil and Gas Fields in Wayne and McCreary Counties, Kentucky" by M. J. Munn, *U. S. G. S. Bull. 579*, 1914.

South and North Dakota. (a) Geologic Map of the Old Standing Rock and Cheyenne River Indian Reservations, North and South Dakota. By

W. R. Calvert, V. H. Barnett, A. L. Beekly, and Max A. Pishel. 1914. 1:500,000. 46°25′-44°30′ N.; 102°0′-100°15′ W. With inset showing location of main map.

(b) Reconnaissance Topographic Map of Parts of the Old Standing Rock and Cheyenne River Indian Reservations, North and South Dakota. Base compiled from General Land Office map. Contours . . . by A. L. Beekly and . . . Max A. Pishel. Surveyed in 1909. 1:125,000. 46°3′-45°8′ N.; 102°-101° W. 2 colors.

Accompany, as Pls. I and II, respectively, "Geology of the Standing Rock and Cheyenne River Indian Reservations, North and South Dakota" by W. R. Calvert, A. L. Beekly, V. H. Barnett and H. A. Pishel, *U. S. G. S. Bull. 575*, 1914.

[Map (a) a black-and-white geological map; map (b) a topographic map with the customary contours in brown (interval 50 ft.) and drainage in blue.]

Utah-Colorado. Map of Parts of Colorado and Utah Showing Present Known Extent of Bituminous Shale. 1:750,000. 40°17′-39°12′ N.; 110°50′-107°47′ W. Accompanies, as Pl. I, "Oil Shale of Northwestern Colorado and Northeastern Utah" by E. G. Woodruff and D. T. Day, *U. S. G. S. Bull. 581-A*, 1914.

Washington. Reconnaissance Map of an Area Examined for Oil and Gas on the West Slope of the Olympic Peninsula, Washington. 1:250,000. 48°2′-47°8′ N.; 124°40′-123°43′ W. Accompanies, as Pl. II, "Oil and Gas in the Western Part of the Olympic Peninsula, Washington" by C. T. Lupton, *U. S. G. S. Bull. 581-B*, 1914.

Western States. (a) Map of the Western States, Showing Areas Covered by Topographic Surveys and the Scale Employed for Each Area. [1:14,200,000]. 51°-29° N.; 127°-101° W. 6 colors.

(b) Map of the Western States, Showing Areas Covered by Geologic Surveys and Kind of Work Done. Same scale and coordinates as map (a). 3 colors.

(c) [Fourteen maps, 1:2,500,000, in three to four colors, showing location of mining districts, viz:] (1) Arizona; (2) Northern Counties of California; (3) Southern Counties of California; (4) Colorado; (5) Idaho; (6) Montana; (7) Nevada; (8) New Mexico; (9) Oregon; (10) Part of South Dakota; (11) Western Texas; (12) Utah; (13) Washington; (14) Wyoming.

Accompany: map (a) as Pl. I, map (b) as Pl. II, and the maps under (c) as Pls. III-XVI, "The Mining Districts of the Western United States" by J. M. Hill, *U. S. G. S. Bull. 507*, 1912.

[Map (b) is a helpful index map showing the location and extent, within the region, of all the areas described geologically in the *Geologic Folios, Monographs* and *Professional Papers* of the Survey as well as of all existing geological surveys, whether published or unpublished. The fourteen maps listed under (c) show the location and name of each mining district and the predominant mineral being extracted there.]

Wyoming. Outline Map of the Wind River Basin, Wyoming. 1:625,000. 44°0′-42°20′ N.; 110°-108° W. Accompanies, as Pl. I, "Gold Placers on the Wind and Bighorn Rivers, Wyoming" by F. C. Schrader, *U. S. G. S. Bull. 580-G*, 1914.

AFRICA

German Southwest and Portuguese West Africa. (a) Die deutsche Zone des Okawango nach den Aufnahmen Franz Seiner's im Jahre 1911. Mit Benutzung aller vorhandenen Materialien bearbeitet von H. Nobiling und W. Rux unter Leitung von Paul Sprigade. 1:100,000. 4 colors. In two sheets, viz.:

Blatt 1. [In three parts:] (1) Sektion a. 17°6′-17°39′ S.; 18°35′-19°8′ E. (2) Sektion b. 17°37′-17°44′ S.; 19°8′-19°41′ E. (3) Sektion c. 17°43′-17°49′ S.; 19°41′-20°14′ E.

Blatt 2. [In three parts:] (1) Sektion d. 17°45′ - 18°2′ S.; 20°14′ - 20°47′ E. (2) Sektion e. 17°52′ - 18°4′ S.; 20°47′ - 21°19′ E. (3) Sektion f. 17°56.2′ - 18°16.5′ S.; 21°19.5′ - 21°52.5′ E.

(b) Die Grauwackenzone des Okawango von Libebe bis Popa nach den Aufnahmen Franz Seiner's im Jahre 1911. Mit Benutzung aller vorhandenen Materialien bearbeitet von P. Just unter Leitung von Paul Sprigade. 1:25,000. 18°1.3′ - 18°6.3′ S.; 11°31.7′ - 11°40.6′ E. 4 colors.

(c) Karte der Aufnahmen Franz Seiner's im Kungfeld und nördl. Sandfeld im Jahre 1912. Mit Benutzung aller vorhandenen Materialien bearbeitet unter Leitung von Paul Sprigade von H. Nobiling. 1:500,000. 17°52′ - 20°0′ S.; 18°33′ - 20°35′ E. 2 colors.

Accompany: map (a), as Karten 5 and 6, map (b) as Karte 7 and map (c) as Karte 8, "Ergebnisse einer Bereisung der Omaheke in den Jahren 1910-1912" by F. Seiner, *Mitt. aus den Deutschen Schutzgeb.*, Vol. 26, 1913, No. 3, pp. 225-316.

[Map (a) a very complete map of the valley of the Kubango, or Okawango, River, from just above where it begins to form the boundary between German Southwest and Portuguese West Africa to its entrance into British territory (Bechuanaland). River bluffs in brown shading, part of the flood-plain periodically inundated in buff, permanent watercourses in blue, periodic in green; there are also very complete indications as to vegetation. A minor point: the reference, in the legends explaining the symbols used to denote the click sounds, to the palatal sound as "palatinaler Schmalzlaut" almost seems like an unconscious assimilation to "Palatinate"; in the text (p. 299) the correct form, "palatalis," is used. Map (b) covers, on four times as large a scale, the central part of the stretch of the river shown in Sektion f. Map (c) is a general map, on a large scale, however, of the Kungfeld, a sand desert on the western edge of the Kalahari province (as defined by Passarge), crossed diagonally from southwest to northeast by the periodic Omurambu-u-Omatako, which debouches into the Okawango.]

Kamerun-Nigeria. (*a*) Übersichtskarte der deutschen Grenze zwischen Yola und den Crossschnellen, bearbeitet von M. Moisel. 1:2,000,000. 9½° - 3° N.; 8° - 14° E. 5 colors.

(b) Karte des Triangulationsnetzes der Yola-Crossschnellen-Grenzexpedition (1907-1909) mit der Eintragung der 1912 vermarkten Grenze. 1:1,000,000. 9° - 5⅘° N.; 9° - 12½° E. 1 color.

(c) Grenzgelände zwischen Pfeiler 24 u. 35. Aufgenommen u. gezeichnet von Oberleutnant Detzner, November 1912. [1:300,000.] [8⅗° - 8° N.; 11⅛° - 11⅗° E.]

(d) Das Quellgebiet des Suntai-Flusses. Aufgenommen und gezeichnet von Oberlt. Detzner, Dezember 1912. [1:210,000]. [7¾° - 7½° N.; 10½° - 11° E.]

Accompany: map (a) as Karte 9, map (b) as Tafel 2, and map (c) and (d) on pp. 321 and 323 respectively, "Die nigerische Grenze von Kamerun zwischen Yola und dem Cross-Fluss" by H. Detzner, *Mitt. aus den Deutschen Schutzgeb.*, Vol. 26, 1913, No. 4, pp. 317-338.

[Map (a) a general map showing the Kamerun-Nigeria boundary as recently laid down by the boundary commission, of the German contingent of which the author was the chief. Map (b) shows the triangulation system and, in red, the precise course of the boundary. Maps (c) and (d) are details in black-and-white of two sections of the boundary; relief is in contours.]

ASIA

China. Cartes itinéraires d'I tch'ang à Yun nan fou et Li Kiang par le Yang tseu Kiang et la vallée du Kien tch'ang; Voyage du Comte Ch. de Polignac, levés du Capitaine de frégate Audemard. 1910. [One general map, one index map, and 15 sheets of route surveys, accompanied by an "Index Géographique," in cloth pocket, as follows:]

(a) De Changhai à I tch'ang par le Yang tseu Kiang. Carte dressée par le Capitaine de frégate Audemard d'après les documents les plus récents. 1912. 1:1,250,000. 32⅗° - 28½ N.; 111½° - 122° E. Oriented N. 12° E. 3 colors.

(b) Carte-index des itinéraires. 1:3,000,000. [32½° - 24° N.; 98° - 111½° E.]. Oriented N. 19° E. 3 colors.

(c) [15 sheets of route surveys, in 2 colors, unless otherwise noted, viz.:] (1) Yang-tseu Kiang d'I-tch'ang à Tch'ong k'ing. 1:560,000. 31°15' - 29°30' N.; 106°20' - 111°20' E. Oriented N. 15° E. 1 color. With inset: Croquis du Yang-tseu kiang de Tch'ong k'ing à Soui fou. 1:850,000. 29°40' - 28°40' N.; 104½° - 106½° E. Oriented N. 15° E. 1 color. (2) De Tch'ong k'ing à Tseu lieou tsing. 1:250,000. 29°43' - 29°11' N.; 104°29' - 106°44' E. Oriented N. 2° W. (3) Tseu lieou tsing à Tch'eng) tou. 1:250,000. 30°45'-28°58' N.; 103°50' - 105°6' E. Oriented N. 59° W. (4) Kia ting-Tch'eng tou-Kouan hien (Rivière Min). 1:200,000. 31°10' - 29°32' N.; 103°20' - 103°35' E. Oriented N. 90° W. (5) De Kia-ting au Mont Omi. 1:60,000. 29°38' - 29°30' N.; 103°15' - 103°43' E. Oriented N. 10° E. (6) De Omi-hien à Ya-tcheou. 1:75,000. 30°0' - 29°37' N.; 102°59' - 103°32' E. Oriented N. 19° W. (7) De Ya tcheou à Ts'ing k'i hien. 1:60,000. 30°0' - 29°33' N.; 102°34' - 103°2' E. Oriented N. 48° E. (8) De Ts'ing k'i hien à Ning yue. 1:60,000. 29°34' - 29°1' N.; 102°30' - 102°40' E. Oriented N. 80° E. (9) De Ning yue à Yue shi t'ing. 1:60,000. 29°3' - 28°35' N.; 102°28' - 102°35' E. Oriented N. 90° E. (10) De Yue shi t'ing à Lou Kou (vallée du Kien tch'ang). 1:60,000. 28°37' - 28°15' N.; 102°8' - 102°31' E. Oriented N. 53° E. (11) De Lou kou à Ning yuan fou (vallée du Kien tch'ang). 1:60,000. 28°19' - 27°52' N.; 102°4' - 102°13' E. Oriented N. 96° E. (12) De Ning yuan fou au Ya long (vallée du Kien tch'ang). 1:60,000. 27°54' - 27°40' N.; 101°51' - 102°17' E. Oriented N. 26° E. (13) De Ning yuan à Yun nan fou. Carte dressée d'après les documents les plus récents. Le levé du Yangtseu et du Yalong par le Capitaine de frégate Audemard. 1:450,000. 27°55' - 24°30' N.; 101°30' - 103°0' E. Oriented N. 8° E. (14) De Li kiang à Tong tch'ouan. Carte dressée d'après les documents les plus récents. Le levé du Yang tseu et du Yalong par le Capitaine de frégate Audemard. 1:450,000. 26°53' - 25°35' N.; 100°10' - 103°35' E. Oriented N. 9° W. (15) De Tong tch'ouan à Soui fou. Carte dressée d'après les documents les plus récents. Le levé du Yang tseu kiang par le Capitaine de frégate Audemard. 1:450,000. 29°3' - 26°15' N.; 102°20' - 104°50' E. Oriented N. 29° W.

[Important maps embodying the results of a journey which led up the Yang-tze-kiang valley to Szechwan and Yunnan. The exploratory portion of the journey began at Ichang on the Yang-tze-kiang in 111½° E. (the route from Shanghai to this point is shown on map (a)). From here the route lay by boat up the Yang-tze-kiang to Chung-king (106⅝° E.), thence overland across the Red Basin of Szechwan, first west and then north to Cheng-tu, the capital of the province. From Cheng-tu the upper Min River was followed south to Kia-ting. Thence the route led first northwest, up the Yaho, to Yachow and then south-southwest along the inner side of the Ta liang shan, the easternmost of the constricted meridional ranges which form the transition between the ranges enclosing the Tibetan plateau and the mountains of Farther India. Crossing the next meridional range to the west from Ning-yüan the route led south down the Ya lung to its confluence with the Yang-tze-kiang in about 102°. From here the Yang-tze-kiang was ascended to abreast of Likiang (27° N.) and then descended again for its whole length to Ichang, with an overland trip from its southernmost bend at Lungkai (26° N.) to Yün-nan-fu and back. The route from Cheng-tu to the Yalung is shown in great detail (sheets 4-12; scale 1:60,000), while the remainder of the territory traversed is shown on relatively large-scale maps, which also embody all other work done in the region. On the detailed maps relief is shown in generalized contours in black; the large-scale maps lack relief, showing only the hydrography (in blue), the roads (in red) and the towns (in black). The range of expression is, on the whole, somewhat less inclusive than on Dr. Tafel's comparable route surveys in the Hoang-ho region (cf. under "China," *Bull.*, Vol. 45, 1913, pp. 877-879), which is not astonishing in view of the fact that these were made by a geologically trained geographer and the present surveys by a naval officer. Aside from the value, as such, of careful route surveys in China, the importance of the present maps lies in the more correct representation they afford of the upper Yang-tze-kiang than heretofore available. A detailed comparison of

the river's course above Suifu as represented in such standard sources as the *Atlas Universel de Géographie* and the China Inland Mission's *Atlas of the Chinese Empire* will bear this out. A preliminary map of this part of the journey was published in *La Géographie* in 1911 (ct. under "China" (first entry), *Bull.*, Vol. 44, 1912, p. 79). An expansion to the north of Audemard's survey of the Yalong was carried out by the Mission Legendre (cf. under "China," *Bull.*, Vol. 45, 1913, p. 319.]

Other Maps Received

NORTH AMERICA

Canada

Alberta. Harrison & Ponton's map of the city of Calgary, Province of Alberta. 1 in. to 1,200 ft. [1:14,400]. [Blue print]. Harrison, Ponton & Parker, Calgary, 1912. [Gift from the City Engineer, Calgary, Alta.]

Driscoll & Knight's map of the City of Edmonton, Province of Alberta. 1 in. to 1,200 ft. [1:14,400]. Driscoll & Knight, Edmonton, 1912. [Gift from the City Engineer, Edmonton, Alta.]

British Columbia. Plan of the City of Victoria, showing sewerage system. 1 in. to 800 ft. [1:9,600]. [Blue print]. Angus Smith, City Engineer [Victoria, B. C.], 1911.

Manitoba. Map of Winnipeg. 1,000 ft. to 1 in. [1:12,000]. City Engineer's Dept., Winnipeg, 1914.

Ontario. Map of the City of Hamilton [Ont.]. 1 in. to 800 ft. [1:9,600]. City Engineer's Office [Hamilton, Ont.], 1913.

Map of the City of London [Ont.], including the newly annexed districts. 1 in. to 800 ft. [1:9,600]. [Blue print]. City Engineer's Office, London, Ont., 1913.

Plan of the City of Ottawa and vicinity. Drawn by F. C. Askwith. Published by Guy R. Dale. Examined and approved by N. J. Ker, City Engineer. 1 in. to 800 ft. [1:9,600]. [Gift from the City Engineer, Ottawa.]

Plan of the City of Toronto. 1 in. to 2,000 ft. [1:24,000]. The City Engineer [Toronto], 1912.

Saskatchewan. Plan of the City of Regina, Saskatchewan. [Blue print]. [The City Engineer, Regina, Sask., 1913].

United States

Alabama. Peavy's map of Mobile, Ala., compiled from recent surveys and Mobile County records. Drawn by John R. Peavy, Jr., C. E., Asst. City Engineer. About 4 in. to 1 mi. [1:15,500]. [The City Engineer, Mobile, Ala.], 1911.

Arkansas. City of Little Rock, Ark. [Blue print]. Department of Public Works [Little Rock, Ark.], 1908.

California. Map of the City and County of San Francisco. 1 in. to 800 ft. [1:9,600]. City Engineer, San Francisco, 1910.

Map of the city and county of San Francisco. Scale about 1 in. to 1,600 ft. [1:19,200]. City Engineer, San Francisco, 1913.

Colorado. Map of the City of Colorado Springs [Col.], compiled in the City Engineer's Office. 1 in. to 800 ft. [1:9,600]. [Blue print]. [The City Engineer's Office, Colorado Springs, Col.], 1913.

Delaware. Plan of Wilmington, Del. 600 ft. to 1 in. [1:7,200]. [City Engineer, Wilmington, Del., 1913.]

Florida. City of Tampa, including city of West Tampa and adjoining territory. 1 in. to 800 ft. [1:9,600]. Sullivan & Isbell, Tampa, 1913. [Gift from the City Engineer, Tampa, Fla.]

Georgia. Map of the city of Savannah and vicinity. 300 ft. to 1 in. [1:3,600]. John W. Howard, City Engineer, Savannah, 1910.

Illinois. Map of the City of Peoria and vicinity. [Blue print]. 1 in. to 1,200 ft. [1:14,400]. [City Engineer, Peoria, Ill., 1913.]

Map of the City of Springfield, Illinois. Published by Hendrickson & Richardson [Springfield, Ill.], 1911. [Gift from the City Engineer, Springfield, Ill.]

Iowa. Council Bluffs, Iowa. 1 in. to 1,320 ft. [1:15,840]. [Blue print]. [The City Engineer, Council Bluffs], 1912.

Map of Cedar Rapids, Iowa, showing streets, parks, public buildings, etc. 6½ in. to 1 mi. [1:9,750]. Compiled and drawn by Iowa Publishing Co., Davenport, Ia., 1909. [Gift from the City Engineer, Cedar Rapids, Ia.]

Map of the City of Waterloo, Iowa, showing streets, parks, public buildings, etc. Compiled and drawn by the Iowa Publishing Co., Davenport, Ia., 1906.

Kentucky. Map of Newport, Kentucky. 1 in. to 300 ft. [1:3,600]. [Blue print]. J. B. Morlidge, City Engineer [Newport], 1913.

Massachusetts. Map of the city of Brockton, Mass. 1,000 ft. to 1 in. [1:12,000]. City Engineer's Office, Brockton, Mass., 1911.

Map of the town of Brookline, Mass. 1 in. to 400 ft. [1:4,800]. Alexis H. French, Town Engineer [Brookline, Mass.], 1911.

Map of the city of Cambridge. 1 in. to 800 ft. [1:9,600]. City Engineer, Cambridge, 1910.

Map of the City of Malden [Mass.]. 1 in. to 444 ft. [1:5,330]. [Blue print]. [The City Engineer, Malden, Mass., 1913.]

Map of Newton, Mass. 1 in. to 1,200 ft. [1:14,400]. Published by Walker Lith. & Pub. Co., Boston, Mass., 1914. [From Edwin H. Rogers, City Engineer, Boston, Mass.]

Map of the City of Quincy, Norfolk County, Massachusetts. 1 in. to 1,500 ft. [1:18,000]. Ernest W. Branch, C. E., Quincy, 1911.

Map of the City of Somerville [Mass.]. 1 in. to 600 ft. [1:7,200]. The City Engineer [Somerville], 1910.

The Price & Lee Company's new map of the city of Springfield, Mass. 1,200 ft. to 1 in. [1:14,400]. Price & Lee Co., Springfield, Mass., 1912. [Gift from the City Engineer.]

Map of Taunton [Mass.]. 1 in. to 2,000 ft. [1:24,000]. Published by Sampson & Murdoch Co., Boston, 1912. [Gift from the City Engineer, Taunton, Mass.]

Map of Waltham, Mass. 1 in. to 800 ft. [1:9,600]. Bertram Brewer, City Engineer [Waltham, Mass.], 1911.

Minnesota. Map of Minneapolis. 2¼ in. to 1 mi. [1:28,160]. City Engineer's Office, Minneapolis, 1910.

Map of St. Paul [Minn.]. 2¼ in. to 1 mi. [1:28,160]. Oscar Claussen, Comm. of Public Works, St. Paul, 1913.

Michigan. The City of Saginaw [Mich.]. [Gift from the City Engineer, Saginaw, Mich., 1913.]

City of Flint, Mich. 1 in. to 400 ft. [1:4,800]. [Blue print]. [The City Engineer, Flint, Mich.], 1914.

Missouri. City of St. Joseph, Missouri. [The City Engineer, St. Joseph], 1913.

Nebraska. Map of Lincoln, Lancaster Co., Nebraska. Compiled by Adna Dobson. [The City Engineer, Lincoln, Neb.], 1903.

Street map of South Omaha, Douglas County, Nebraska. 1 in. to 400 ft. [1:4,800]. G. W. Roberts and J. J. Kaspar, Consulting Engineers [South Omaha, Neb., 1913.]

New Jersey. Map of the City of East Orange in Essex County, N. J., surveyed by Wm. H. V. Reimer, C. E. [The City Engineer, East Orange, N. J.], 1911.

New York. Bureau of Engineering map of Albany, New York. 1 in. to 600 ft. [1:7,200]. City Engineer, Albany [1913].

Street map of the City of New Rochelle and the village of Larchmont, Westchester Co., N. Y. 1 in. to 1,200 ft. [1:14,400]. John Fairchild, C. E., Mount Vernon, N. Y., 1913.

Map of Niagara Falls [N. Y.]. 1 in. to 1,000 ft. [1:12,000]. [Blue print]. City Engineer [Niagara Falls, N. Y.], 1909.

Map of the City of Watertown, N. Y. Revised by E. W. Sayles, City Engineer. [Blue print]. [The City Engineer, Watertown, N. Y.], 1910.

Ohio. Map of the city of Akron [Ohio]. [1:14,400]. [The City Engineer, Akron, O.], 1911.

New mechanical index map of Canton, O., and vicinity. About 6 in. to 1 mi. [1:10,500]. Mechanical Index Map Pub. Co., Canton, O., 1913. [Gift from the City Engineer.]

[Map of] Cleveland, O. 2 in. to 1 mi. [1:31,680]. City Engineer's Office, Cleveland, 1910.]

Map of Columbus, O. 1 in. to ½ mi. [1:31,680]. [City Engineer's Office, Columbus, O., 1911]. [9 editions, showing:] (1) wards; (2) telephones; (3) railways and light; (4) street railways; (5) natural gas; (6) gas and fuel co.'s lines; (7) artificial gas; (8) waterworks; (9) sewers.

Map of Lorain, Ohio. Compiled from official records and actual surveys. 1 in. to 400 ft. [1:4,800]. C. M. Osborn, City Engineer [Lorain, O.], 1914.

Map of the City of Newark, Ohio. 1 in. to 500 ft. [1:6,000]. [Blue print]. [The City Engineer, Newark, O.], 1908.

Street and road map, city of Youngstown, Ohio. Scale about 2 in. to 1 mi. [1:32,000]. Platting Commissioner's Office, Youngstown, O., 1913.

Oklahoma. Donald's new pocket map of Muskogee, Oklahoma, revised and up-to-date. The official pocket map and street guide. The City Engineer [Muskogee], 1911.

Oregon. Hanson & Garrow's map of Portland and vicinity. 3 in. to 1 mi. [1:21,120]. Hanson & Garrow [Portland], 1912. [Gift from the City Engineer, Portland, Ore.]

Pennsylvania. Easton, Pennsylvania, showing division of wards. 1 in. to 600 ft. [1:7,200]. City Engineer, Easton, Pa., 1908.

Map of the city of Wilkes-Barre. [1:7,200]. Office of the City Engineer, Wilkes-Barre, Pa., 1912.

City of Williamsport, Pennsylvania, and suburbs. 1 in. to 1,000 ft. [1:12,000]. [Blue print]. [The City Engineer, Williamsport, Pa.], 1913.

Pennsylvania-New Jersey. Map of Philadelphia, Camden, and vicinity, compiled from city plans and personal surveys. 1:24,000. Published by Elvino V. Smith, C.E., Philadelphia, 1910.

Rhode Island. Map of Providence, R. I. 1,200 ft. to 1 in. [1:14,400]. Correct to spring of 1913. Published by Walker Lith. & Pub. Co., Boston. [Gift from the City Engineer.]

South Carolina. Map of the City of Columbia, S. C., showing street grades. 1 in. to 300 ft. [1:3,600]. [Blue print]. The City Engineer [Columbia, S. C.], 1912.

Texas. Map of city of Austin. C. E. Leonard, City Engineer [Austin, 1913].

Map of the City of El Paso, Texas, compiled by E. C. Baer. 1 in. to 1,000 ft. [1:12,000]. [Blue print]. [The City Engineer, El Paso, Tex.], 1909.

Utah. Map of Salt Lake City. 1,000 ft. to 1 in. [1:12,000]. City Engineer's Office, Salt Lake City, Utah, 1913.

Virginia. Map of the City of Lynchburg, Va. 1 in. to 400 ft. [1:4,800]. H. L. Shaner, City Engineer [Lynchburg, Va.], 1910.

Map of the City of Norfolk and vicinity, as authorized by the City Council. 1 in. to 800 ft. [1:9,600]. Office of the City Engineer, Norfolk, Va., 1909.

Map of Roanoke, Va. 6 in. to 1 mi. [1:10,560]. [Blue print]. F. L. Gibboney, City Engineer [Roanoke, Va.], 1914.

Washington. Spokane, Washington. [1:34,200]. Office of the City Engineer, Spokane, Wash., 1912.

West Virginia. City of Wheeling [W. Va.]. 1 in. to 800 ft. [1:9,600]. [Blue print]. City Engineer's Office [Wheeling, W. Va.], 1913.

Wisconsin. General map of City of Madison [Wis.]. 1 in. to 700 ft. [1:8,400]. E. E. Parker, City Engineer [Madison, 1913].

[The above city maps were kindly sent to the Society in response to a request addressed to the city engineers of all American cities with a population of 25,000 or more and Canadian cities of 100,000 or more. All cities of this size, it will be noted, are not represented, and the list makes no claim to completeness. An effort will be made, however, to procure the missing maps, as it is desired to make the collection as complete as possible.

No individual comment need be made, as the maps all belong to the same general type. From the geographer's standpoint they are disappointing. As a rule they merely show, usually by parallel, sometimes even only by single lines, the network of streets, and their names. Sometimes no distinction is even made between existing and proposed streets. The better maps may indicate urban transportation lines and some, public buildings. But the critical element which interests the geographer—the built-up area—is practically never shown. A city is, after all, mainly an aggregation of houses, and it is in their distribution that a geographer is interested. That the representation of this element in a city map is not an impossible requirement is shown by the admirable maps published by European, mainly Continental, municipal authorities or those issued by private publishers that there can be bought for a few cents at any book shop. For such investigations as Messrs. Hassert, Oberhummer, Hassinger and Blanchard have so successfully undertaken abroad, the American student of city geography is almost at a loss where to turn for material with regard to his own cities. The type of map listed above will not tell him where are the real geographical limits of the city, nor will they enable him to differentiate between business, city residence and suburban sections. The only map of this type known to the reviewer is the admirable map of New York, 1:21,600, issued by the Topographical Bureau of the Board of Public Improvements for the Paris Exposition of 1900; and even this has not been kept up-to-date. *Faute de mieux,* the topographic sheets of the U. S. Geological Survey can be of assistance, as frequently pointed out in this department; but their scale is rarely large enough for problems of city geography. Or else recourse may be had to that friend in need, Baedeker's "United States"; but there one finds that even for so excellent cartographers the problem has been too difficult. Following the standard of their European guide books, they have endeavored to indicate the built-up area, but the lack of material has forced them to guess, and, although they have done so intelligently, the result necessarily cannot be accurate. Information as to the built-up area is, of course, available: it can be found in the offices of superintendents of buildings, in insurance atlases and the like, but not in the form suited to the geographer. As in many other phases of his work, so in city geography, he is still constrained to prepare for himself the fundamental material for his inquiries.]